Technology’s Impact on the Development of the Law

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I. Introduction

The Internet of Things, artificial intelligence, big data, autonomous vehicles, robotics, drones and genetic engineering are examples of disruptive technologies. We are on the cusp of a new industrial revolution driven by technology. Who can or should be liable when machines make life and death decisions on their own, or when mathematic algorithms use bad data or make the wrong decision? Our panel will provide a glimpse into these types of issues spanned by technology that our courts will soon address.
II. Automated Driving and Product Liability

AUTOMATED DRIVING
AND PRODUCT LIABILITY

Bryant Walker Smith*

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INTRODUCTION

Cyberphysical systems—computers that act in and on the physical world—are proliferating rapidly. These systems have the potential to address some of today’s dangers, deprivations, and desires, and to create opportunities unimagined. Occasionally, however, they will cause injuries that otherwise would not have occurred. The inevitability of injury invites speculation about how product liability law will address these cases and impact these systems.

In one sense, this is a problem: “a question raised for inquiry, consideration, or solution.” It deserves and perhaps demands

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thoughtful analysis. Descriptively, how are the evolving rules of product liability law likely to apply to these systems? Normatively, how should they apply? A problem of this kind is to be initially “solved,” if at all, through exploration rather than legislation.

Often, however, the “liability problem” means something different. It is an obstacle to be removed, the object of consternation rather than contemplation. In the case of automated driving systems, liability apparently must be “solved” before these systems can be deployed to the public. On this view, the focus rapidly jumps from understanding the problem to enacting the solution.

Product liability law may pose particular functional challenges for the development and deployment of cyberphysical systems. Likewise, cyberphysical systems may pose particular functional challenges for the operation of product liability law. But neither exists to promote the other. Rather, these challenges should be identified and evaluated with reference to broader societal goals, including safety and welfare.

This Article focuses on one cyberphysical domain—automated driving—to methodically analyze the so-called liability problem. It considers how automated driving could affect product liability, how product liability could affect automated driving, and how each could advance or impede the prevention of injury and the compensation of victims.

The Article concludes that the current product liability regime, while imperfect, is probably compatible with the adoption of automated driving systems. These systems, when introduced, are likely to be substantially safer than human-driven vehicles. Because driving decisions will shift from human drivers to automated systems (and their designers), a larger share of the crashes that nonetheless occur will implicate product liability law. This means that, in comparison to the automotive industry today, the automated driving industry will likely bear a bigger slice of a smaller pie of total crash costs. Under conservative assumptions, these costs are large—but not extraordinarily so.

2. See Problem, supra note 1 (“a source of perplexity, distress, or vexation”).
Introducing automated driving as a service rather than as a product may be a more effective way of passing these costs to the motorists who, along with victims and the broader public, already pay for the costs of crashes today. Service models such as driverless taxis and delivery robots would help consumers avoid paying large upfront costs and would provide manufacturers with a flexible revenue stream that could help them better manage inevitable uncertainty about their liability exposure.

This analysis is a sketch to be critiqued and completed. It relies heavily on numbers that are imprecise and assumptions that are arbitrary. The results are presented with a minimum of significant digits and should be viewed as order-of-magnitude estimates. Experts from other domains and with access to other (likely proprietary) data can play an important role in refining these estimates. In short, the Article does not claim to be definitive, but it does try to be deliberate.

**Who Cares?**

Many people seem to care about the question of liability in the context of automated driving. It is the subject of countless news articles, multiple academic articles, and at least two publicly funded reports. The question of “who is liable” is frequently posed at public events, though more recently it has been eclipsed somewhat by ruminations on runaway trolleys.

The public focus on liability may reflect some combination of fear and fascination. Perhaps those who wonder about it are essentially asking how law can bring order to an uncertain future; or perhaps liability is an indirect way of talking about death and destruction—a respectable veneer on an evolutionarily useful preoccupation with the macabre. Such speculation runs beyond this Article.

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5. See infra notes 120, 146, 213, 214, 246, 280.

6. See infra notes 17, 293.

But who should care—and why? Developers and manufacturers of automated driving systems should care because they will be defendants in injury cases. The lawyers who will litigate these cases should also care. Liability should also matter to people who will actually be harmed in automated driving crashes and to people who could be injured in crashes of any kind. This last statement tracks two principal goals of civil liability: compensation and safety.8

These goals are common to both vehicular negligence and product liability. As used in this Article, vehicular negligence refers primarily to personal injury claims against individual motorists or their principals, while product liability includes claims against companies that allegedly made or sold a defective product.9 This Article focuses on the shift from a compensation regime for conventional driving that is largely premised on vehicular negligence10 to a compensation regime for automated driving that increasingly implicates product liability.

The compensatory function of product liability is intended to make victims of product defects whole again by returning them to the condition they were in before the relevant injuries. Similarly, tort law’s compensatory function is intended to restore victims of wrongful acts more generally, including negligent driving. As explored below, crashes can impose tremendous costs on those who are injured in them. Shifting from a regime premised on vehicular negligence to one premised on product liability will advance this compensatory function if and only if that shift makes more of these costs recoverable.

The safety function of product liability is intended to incentivize manufacturers and consumers to take reasonable safety precautions. Ideally, product liability will deter manufacturers from selling products that are not reasonably safe without deterring these manufacturers from selling useful products that are reasonably safe.11


9. See infra notes 11-14. Product liability can encompass other claims as well.

10. This also includes states with no-fault crash regimes.

The regime’s actual impacts on safety and innovation, unfortunately, are unclear and contested. In simplistic terms, some may view product liability as a potential impediment to the development and adoption of automated driving systems that could save lives, while others may view product liability as a tool to ensure that these systems are responsibly deployed and continually improved. On either view, product liability’s impacts result from a combination of exposure to liability and uncertainty about the extent of that exposure.

Liability exposure refers to the actual product liability costs that a company will incur. In theory, if a manufacturer can confidently predict these costs, then it can pass them onto its customers through the prices that it charges. The same is true for the insurer to which that manufacturer may turn. In this way, product liability helps to internalize some of the costs of injuries. Between two otherwise identical products, the safer one should be less expensive and hence more attractive to buyers.

Differences between vehicular negligence and product liability could distort the relative economics of automated driving and conventional driving. Imagine that a conventional vehicle and a vehicle with an automated driving system cost the same to actually manufacture and market. Further assume, subject to the discussion below, that the manufacturer’s liability exposure is greater for the vehicle with the automated driving system than for the one without. In that case, the more advanced vehicle will cost more upfront, even if it is substantially safer.

In this example, the higher purchase price of the vehicle with the automated driving system might theoretically be offset by increased safety, especially as reflected by lower automotive insurance premiums. However, a purchaser may not compare the overall cost of ownership. Moreover, to the extent that more crash...
costs are internalized under product liability than under vehicular negligence, the conventional vehicle may still appear to be cheaper.

In short, liability exposure could conceivably lead to higher prices for automated driving systems, which could lead to slower adoption of these systems, which could lead to crash injuries that could have been prevented by these systems.

In contrast to exposure, liability uncertainty refers to lack of confidence about the actual product liability costs that a company will incur. If an automated driving developer is unable to confidently predict its liability costs, it may either delay deployment of its system or conservatively price that system to account for the possibility of high liability costs. Similarly, insurers may decline to cover that developer or the would-be buyers of its system, or they may demand higher premiums to do so.

In those cases, liability uncertainty could lead to slower deployment of or higher prices for automated driving systems, which could lead to slower adoption of these systems, which could lead to crash injuries that could have been prevented by these systems.

These scenarios are possibilities, not predictions. The majority of this Article develops a foundation for evaluating these possibilities by examining the relationship of both automated and conventional driving to (1) crashes, injuries, and fatalities; (2) the societal cost of crashes; (3) the technical failure of vehicles and their components; (4) the product liability of developers, manufacturers, and operators; and (5) the availability and adoption of products and services.

One prominent simplifying assumption throughout this analysis requires upfront explanation. Many of the numbers that follow stipulate or assume 100% automated driving across all vehicles and all trips. This assumption is pure fantasy. However, this assumption facilitates straightforward comparison with current driving statistics without distorting those comparisons. The National Highway Traffic Safety Administration’s (NHTSA) analysis of the safety benefits of vehicle-to-vehicle communication likewise assumed universal adoption.  


17. JOHN HARDING ET AL., NHTSA, DOT HS 812 014, VEHICLE-TO-VEHICLE COMMUNICATIONS: READINESS OF V2V TECHNOLOGY FOR APPLICATION, at
In reality, there are multiple pathways to fully automated driving, including advanced driver assistance systems that assume an increasing share of the driving task, automated emergency intervention systems that intervene in increasingly assertive ways, and truly driverless systems that operate in increasingly challenging environments. Each of these systems will need to interact with human drivers, bicyclists, pedestrians, and other conventional road users. These interactions may be especially challenging, and the crashes that result from them will raise particular questions within product liability law.

CRASHES, INJURIES, AND FATALITIES

Two Bay Area families suffered a devastating loss after two mothers and their four children were killed in a fiery minivan accident on Interstate 5 near the community of Gorman in Los Angeles Tuesday morning. Officials had to hold back two hysterical fathers from the flames as they tried to rescue their family. ABC7 News learned the children were ages 2, 3, 4 and 5 years old. The minivan was partially in the right-hand lane after a minor wreck on Interstate 5 near the community of Gorman, about 65 miles north of downtown Los Angeles. A semi-truck going about 55 mph slammed into the van from behind, sending it off the road and down an embankment, where it quickly caught fire, CHP Officer Frank Romero said. The two fathers, who were in the driver's and passenger seats at the time of the crash, suffered burns trying to save their wives and four children, Romero said.

This is a recent crash report selected at random. There are many more like it because some 35,000 people die on U.S. roads every year. This is roughly one hundred deaths every day and, as many others have observed, equivalent to two large commercial airplanes colliding every week. Motor vehicle crashes are a leading

18. Walker Smith, supra note 16.
19. See infra notes 213-15 and accompanying text.
22. For reference, a common commercial airplane, the Boeing 747-8, carries a maximum of roughly 467 passengers. See BOEING, 747-8 AIRPLANE CHARACTERISTICS FOR AIRPORT PLANNING 13 (2012), http://www.boeing.com/assets/
cause of death by injury, and for Americans between fifteen and twenty-four, the leading cause of death. More than 15% of those killed in crashes are bicyclists and pedestrians.

Fatalities are just one measure of the destruction on U.S. roads. Crashes also injure nearly four million Americans every year. Approximately six million crashes are reported to the police every year, and at least as many less severe crashes likely go unreported.

At the same time, roadways are significantly safer than in the past. In the late 1960s and early 1970s, crashes annually claimed more than 50,000 lives even though Americans were cumulatively driving less than half the three trillion miles that they currently travel each year. Fatalities have declined from this peak both in absolute


25. There is also a difference between fatal crashes and crash fatalities, since a single crash may involve multiple fatalities. Similarly, injury crashes can—and often do—involves more than one injury. For simplicity, this Article generally references fatalities and injuries as well as police-reported crashes.


27. Id. at 13.

28. Id.


terms and much more dramatically relative to vehicle miles traveled. Figure 1 shows this relative change.\footnote{TRAFFIC FATALITIES, supra note 29; HISTORICAL VMT REPORT, supra note 30.}

\begin{figure}[ht]
\centering
\includegraphics[width=\textwidth]{fatalities_per_billion_vehicle_miles_traveled.png}
\caption{Fatalities Per Billion Vehicle Miles Traveled in the United States}
\end{figure}

A focus on fatalities, however, can obscure as much as it can reveal. An annual fatality count does not indicate whether, in comparison to years past, a vehicle today is less likely to crash (or crash severely), the individuals involved are less likely to sustain injuries, or those injuries are less likely to be fatal—and, if so, why. More recent data on nonfatal crashes, while far from precise or consistent, suggest some combination of these factors. Figure 1, for example, shows the declines in rates of fatalities, injuries, and police-reported crashes\footnote{While not shown on this graph, the rate of fatal crashes has decreased more slowly than the rate of fatalities, and the rate of injury crashes has likewise decreased more slowly than the rate of injuries. \textit{See supra} note 25; NAT’L CTR. FOR STATISTICS & ANALYSIS, NHTSA, DOT HS 812 246, 2014 MOTOR VEHICLE CRASHES: OVERVIEW 2 (2016), https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812246 [https://perma.cc/SGL9-V7DM] (comparing the decreasing rate of injuries to that of fatalities over the past 20 years).} relative to 1994.
Figure 2

Change in Reported Crashes, Injuries, and Fatalities per Vehicle-Mile Traveled Since 1994
Automated Driving & Product Liability

Historically, improvements in vehicle design have reduced the rates of some kinds of crashes and increased the survivability of the crashes that nonetheless occur. About a dozen automotive safety features covered by the Federal Motor Vehicle Safety Standards—including seatbelts, air bags, and energy-absorbing steering assemblies—are estimated to have saved nearly 28,000 lives in 2012 alone.

Unfortunately, the current model of individual vehicle ownership means that new technologies can take decades to be prevalent in the nationwide fleet. The average age of a motor vehicle is about eleven years. If this ownership model persists, then electronic stability control, for example, will be in less than 90% of registered vehicles until the late 2020s. This technology saved over 1,000 lives in 2012 even though it was then on less than half of all registered vehicles.

Seatbelts are an earlier success story involving both vehicle design and occupant behavior. Three-point seatbelts were introduced into the United States by Volvo in the early 1960s and are now used by nearly nine out of ten drivers nationwide (with substantial

34. Id. at 227.
37. See LUND, supra note 35, at 53-54.
39. See LUND, supra note 35, at 54.
variation among the states). In 2014, unrestrained occupants accounted for only 13% of travelers but nearly 50% of fatalities. In other words, wearing a seatbelt is one of the best ways to survive a crash.

Driver behavior remains the most significant determinant of whether a crash actually occurs. (This fact, unfortunately, is often lost in news about the latest vehicle defects.) Driver error plays a role in some 94% of motor vehicle crashes today. These errors include inattention, distraction, inadequate surveillance, excessive speed, incorrect assumptions, misjudgments, illegal maneuvers, overcompensation, poor directional control, and simply falling asleep. Three overlapping factors—alcohol impairment, speeding, and driver distraction—are particularly noteworthy.

In 2014, 31% of roadway fatalities involved alcohol impairment. In contrast, a roadside survey conducted by NHTSA detected illegal levels of alcohol on the breath of 0.4% of drivers during weekday daytime hours and 1.5% of drivers during weekend

42. Id.
43. 2014 MOTOR VEHICLE CRASHES, supra note 32, at 3-4. In 2007, when average usage was 82%, about 5,000 people died because they were not properly belted. CHEN, supra note 41, at 2; see also NHTSA, DOT HS 811 105, LIVES SAVED FAQs 13 (2009), https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811105 [https://perma.cc/47L6-2TN3].
45. Cf NHTSA, DOT HS 808 795, MOTOR VEHICLE SAFETY DEFECTS AND RECALLS: WHAT EVERY VEHICLE OWNER SHOULD KNOW (2011), http://wwwodi.nhtsa.dot.gov/recalls/recallprocess.cfm [https://perma.cc/7AQQ-Q9PY] (“In 2009, approximately 30,000 lives were lost on our Nation’s highways... Clearly, there is a need for dramatic improvement in motor vehicle safety. Getting unsafe vehicles off the road is integral to improving safety and saving lives.”).
46. SINGH, supra note 44, at 1; see also Bryant Walker Smith, Human Error as a Cause of Vehicle Crashes, CTR. INTERNET & SOC’Y (Dec. 18, 2013, 3:15 PM), https://cyberlaw.stanford.edu/blog/2013/12/human-error-cause-vehicle-crashes [https://perma.cc/6HY7-XR7P].
47. See SINGH, supra note 44, at 2.
nighttime hours. 49 (Approximately 15% of drivers declined to provide breath samples.) 50 As Figure 3 shows, higher alcohol levels are associated (except at very low levels) with significantly higher crash probabilities. 51 A driver at the legal limit of 0.08% is nearly four times more likely to crash than a driver with no detectable alcohol, and a driver at twice the legal limit is nearly fourteen times more likely to crash.

Figure 3

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50. Id. at 4. For more discussion of drivers avoiding the test site or refusing to be tested, see Robert B. Voas et al., Drinking and Driving in the United States: The 1996 National Roadside Survey, 30 ACCIDENT ANALYSIS & PREVENTION 267, 267 (1998) (explaining the methodologies of earlier surveys).

51. See RICHARD P. COMPTON & AMY BERNING, NHTSA, DOT HS 812 117, DRUG AND ALCOHOL CRASH RISK 6 (2015), http://www.nhtsa.gov/staticfiles/nti/pdf/812117-Drug_and_Alcohol_Crash_Risk.pdf [https://perma.cc/K6K7-C836] (using data to create Figure 3).
Speeding likely played a role in at least 28% of roadway fatalities.52 “NHTSA considers a crash to be speeding-related if the driver was charged with a speeding-related offense or if an officer indicated that racing, driving too fast for conditions, or exceeding the posted speed limit was a contributing factor in the crash.”53 Speeding is routine,54 and while it may be merely incidental to some crashes, it probably plays an unacknowledged role in far more. Regardless, higher speed is both theoretically and empirically associated with more severe injury in those crashes that do occur.55

Driver distraction was present in 10% of roadway fatalities.56 Distraction associated with electronic devices is of rising concern.57 Preliminary roadway fatality data for 2015 suggest that fatalities increased by approximately 7% over 2014, which is more than twice the rate at which vehicle miles traveled increased.58 Notably, as

53. 2012 SPEEDING, supra note 52, at 1.
56. 2014 CRASH KEY FINDINGS, supra note 48, at 1.
58. 2014 TRAFFIC FATALITIES, supra note 21, at 1.
shown in Figure 2 above, the rate of police-reported crashes began trending upward sooner than fatalities and injuries, which would be consistent with riskier driving in safer vehicles.

These factors, and others, are important to understanding the future of roadway safety, for which automated driving holds tremendous promise. When automated driving systems are eventually deployed, they are likely to be significantly safer than conventional vehicles for at least five reasons.

The first reason is practical: Safer performance is likely to be a social if not a legal prerequisite to market introduction. In informal comments, NHTSA’s administrator has suggested that automated driving should be at least twice as safe as conventional driving. The U.S. Secretary of Transportation, in the context of emphasizing safety, has cited a prediction that automated driving could reduce fatalities by 80%. If these sentiments reflect the eventual expectations of regulators, developers, and consumers, then automated driving will not be a commercial reality unless and until it is in fact safer than conventional driving. (This, of course, does not mean that an automated driving system is safer merely because it has been introduced.)

Second, there is hope that automated driving systems will reduce crash rates by reducing the opportunity for and impact of driver error (more than they increase the opportunity for and impact of other kinds of error such as component malfunction). Automated driving systems may avoid many of the errors, described above, that contribute to some 94% of crashes. At a minimum, they will not be literally drunk. Moreover, they are unlikely to operate at unreasonably high speeds (even if they exceed posted speed limits under some circumstances).

Third, the combination of remote data collection and over-the-air software updates will allow developers to quickly identify and correct some kinds of performance issues. Today’s drivers are largely unable to share the situational expertise and locational

61. See SINGH, supra note 44, at 1.
knowledge that they develop. In contrast, the automated driving systems deployed by a particular developer will act less like 200 million individual drivers and more like a single driver. Vehicle recalls today, which typically involve driving to a repair shop, generally achieve only a 75% completion rate. In contrast, many over-the-air software updates are likely to be fast and universal.

Fourth, vehicles with automated driving systems are likely to be operated either in fleets or with the ongoing involvement of their developers. Consistently maintaining and regularly replacing these vehicles could improve the overall safety performance.

Fifth, automated driving systems may be designed in ways that reduce the severity of crashes that nonetheless occur. Slower speeds mean less crash energy. In addition, at least two automated driving developers have suggested informally in conversations with me that their systems will operate only if every vehicle occupant is wearing a seatbelt. As the numbers above suggest, making seatbelt use a condition of operation could improve crash survival.

Projections of these potential safety benefits are still preliminary. One analysis estimated that a combination of just

64. See, e.g., Rob Matheson, Startup Bringing Driverless Taxi Service to Singapore, MIT News (Mar. 24, 2016), https://news.mit.edu/2016/startup-autonomy-driverless-taxi-service-singapore-0324; see also infra discussion at notes 280-90 (discussing service models).
blind-spot monitoring, lane departure warning, and forward collision warning could, with total adoption and effectiveness, “prevent or reduce the severity of as many as 1.3 million [U.S.] crashes annually, including 133,000 injury crashes and 10,100 fatal crashes.” NHTSA estimated that a “fully mature” vehicle-to-vehicle (V2V) communications system “could potentially address” about 80% of crashes today. Although V2V communications are distinct from automated driving, many of the crash types that NHTSA examined involved perception failures that automated systems may also be able to address.

The common suggestion that “driverless cars” are “already safer” than conventional vehicles remains premature. With the exception of low-speed applications in limited environments, truly driverless motor vehicles do not yet exist in a commercial sense. Advanced driver assistance systems like Tesla’s Autopilot are at most “partial automation” that operate with the expectation that human drivers will actively monitor the roadway and intervene as


69. HARDING ET AL., supra note 17, at 18.

70. See Bryant Walker Smith, A Legal Perspective on Three Misconceptions in Vehicle Automation, in LECTURE NOTES IN MOBILITY: ROAD VEHICLE AUTOMATION 85, 89 (Gereon Meyer & Sven Beiker eds., 2014).


needed. Even Google’s research vehicles are closely supervised by professional safety drivers when on public roads.

Moreover, just because an automated system should be safer than humans does not necessarily mean that it will be safer; surprises abound on roads as well as in software. No company has logged the hundreds of millions of miles that might provide a statistical comparison of actual crash and injury rates, and early empirical claims are necessarily limited. A study commissioned by Google compared conventional driving to supervised automated driving. Tesla’s statements about the relative performance of its Autopilot are lacking.

Even the prediction that automated driving will be safer than conventional driving requires some important caveats. First, this superior safety will be broadly statistical; given everything that happens in the three trillion vehicle miles traveled annually in the United States, there will be individual incidents of diminished safety. Second, early automated driving systems may have limited

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74. On The Road, Google Self-Driving Car Project, https://www.google.com/selfdrivingcar/where/ [https://perma.cc/8DF4-9F57] (last visited Nov. 16, 2016) (“There are test drivers aboard all vehicles for now.”).


76. See Blanco et al., supra note 67.


operational design domains; for example, they may not initially operate in snow or other challenging environments. Third, unlikely systemic risks—of which cyberattacks are the most prominent—could affect this overall safety performance if they are realized on a massive scale. Fourth, automated driving could conceivably increase the rate of minor crashes even while decreasing the rate of more serious crashes.\textsuperscript{80}

A comparison between automated driving and conventional driving also misses the potential contribution of active safety systems intended to assist rather than replace a human driver.\textsuperscript{81} In terms of safety performance, an automated driving system could be compared not only to a human driver but also to that driver as assisted by lane departure warnings, automatic braking, and even more advanced forms of automated emergency intervention. This is discussed more below.

Finally, a substantial increase in vehicle miles traveled could negate some of these potential safety gains. Automation could conceivably induce additional travel by making that travel less stressful, less expensive, or more productive.\textsuperscript{82} Some vehicles may even deliver goods, circulate while waiting for passengers, return home or seek parking after completing a drop off, collect neighborhood data, or display advertising—all without any human on board.\textsuperscript{83} Consider a hypothetical illustration: If automated driving halves the crash rate while doubling the number of vehicle miles traveled, the total number of crashes would stay the same.

For the reasons discussed above, automating every motor vehicle trip could reduce total crash magnitude. In short: Automated driving systems may crash less frequently and less severely, and


\textsuperscript{81} See Bryant Walker Smith, Presentation at the 2012 Road Vehicle Automation Workshop: Autolaw 3.0 (July 24-26, 2012), http://onlinepubs.trb.org/onlinepubs/conferences/2012/Automation/presentations/WalkerSmith.pdf [https://perma.cc/QF43-VZBQ]; see also Walker Smith, supra note 16.

\textsuperscript{82} See Bryant Walker Smith, Managing Autonomous Transportation Demand, 52 SANTA CLARA L. REV. 1401, 1401-02 (2012).

\textsuperscript{83} A crash involving a vehicle making zero-occupancy trips might still injure (only) those outside that vehicle.
those who are involved in these crashes may be better protected. Figure 4 illustrates this broad prediction: The pie on the left (representing crash magnitude today) is larger than the pie on the right (representing crash magnitude if every motor vehicle trip were automated).

Figure 4

Crash magnitude here means the total number of crashes weighted by their severity.\textsuperscript{84} As a practical matter, such weighting is difficult: How many severe injuries, for example, is equivalent to a fatality? Although valuation matters for the subsequent liability analysis, this initial comparison of crash magnitude requires no further granularity or equivalence.

The dotted circle around the right pie illustrates how an increase in vehicle miles traveled could complicate this comparison. However, this potential complication is less relevant to this Article’s focus on managing product liability. There is some relationship between vehicle miles traveled and automaker revenue (as more miles traveled may lead to more frequent vehicle turnover) and an even stronger relationship between vehicle miles traveled and operator revenue (as ride services often charge at least in part by distance traveled). This means that more miles traveled could mean both more crashes and more revenue to offset that potential liability.

\textsuperscript{84} A thousand injury-free crashes may be preferable to a single fatal crash. At the same time, the costs associated with a severe injury (such as lifetime medical care) may be more recoverable than those associated with a fatality. See infra discussion at notes 87-100.
CRASH COST

In 2010, motor vehicle crashes in the United States imposed societal costs of some $836 billion. This figure—$836,000,000,000—is the most recent to come from NHTSA’s multi-decade effort to understand the costs of driving. That complex undertaking is the focus of this section.

About one-third of the $836 billion accounts for “the value of resources that are used or that would be required to restore crash victims, to the extent possible, to their pre-crash physical and financial status.” These economic costs include $23 billion in medical expenses, $76 billion in property damage, $77 billion in lost productivity, $28 billion in congestion impacts, and $37 billion in additional economic costs. They can be “estimated in a fairly direct manner through empirical measurements.”

The remaining two-thirds represents both loss of life and diminished quality of life. “In the case of death, victims are deprived of their entire remaining lifespan. In the case of serious injury, the impact on the lives of crash victims can involve extended or even lifelong impairment or physical pain, which can interfere with or prevent even the most basic living functions.” The value of a statistical life (VSL) can be used to represent the cost of a fatality and scaled for a nonfatal injury. VSL is inferred from how much consumers will either pay to avoid a risk of death or demand to accept a risk of death. The $836 billion is based on a VSL of just under $9 million; using other established values produces total costs ranging from about $500 billion to over $1 trillion.

85. BLINCOE ET AL., supra note 26, at 5 (in 2010 dollars). In 2010, there were “32,999 fatalities, 3.9 million non-fatal injuries, and 24 million damaged vehicles.” Id. at 1.
86. Id.
87. Id. at 113.
88. Id. at 5.
89. Id. at 113.
90. Id.
91. Id. at 116. Because some costs that are explicit in the economic calculations are implicit in the VSL measure, “combining measures of economic costs and lost quality-of-life requires an adjustment to avoid double counting these components.” Id. at 117.
92. Id. at 113-14. For example, “willingness to pay” studies (WTP) are most frequently based on wage rate differentials for risky jobs, or on studies of the prices consumers pay for products that reduce their risk of being fatally injured.” Id. at 113.
93. Id. at 114 (2010 dollars based on 2012 dollars).
94. Id. at 10.
As Figures 1, 2, and 3 illustrate, crash injuries vary widely in severity and hence in cost. Crashes involving property damage only (PDO) account for a vast majority of total crashes but less than 10% of total crash costs. In contrast, fatal crashes account for less than half of 1% of all crashes but over a third of total crash costs. This is because of the high costs of each fatality. Depending on the severity, injuries can also cost millions of dollars. These costs are only averages, and “in individual cases they can be exceeded by a factor of three or more.”

Figure 5

![Number of crash victims by injury severity](image_url)

95. See id. at 13, 16, 17 (2010 numbers). For simplicity, the paragraph above references crashes. In contrast, the figures reference crash victims and, in the case of property-damage only (PDO) crashes, crash vehicles. A single crash can involve multiple victims with different levels of severity. The “no injury” category on the figures (and in the NHTSA report on which they are based) refers to uninjured participants of crashes in which others were injured. Id.

96. Id.


98. Blincoe et al., supra note 26, at 4.

99. See id. at 26.

100. Id. at 8.
Automated Driving & Product Liability

Figure 6

Mean cost per victim by injury severity

![Graph showing mean cost per victim by injury severity.](image)

Figure 7

Comprehensive cost by injury severity (in billions)

![Pie chart showing comprehensive cost by injury severity.](image)
Who actually pays these costs?

Most of the total burden falls on the direct and indirect victims of tragic crashes. The child who never reaches adulthood loses something of intrinsic value even though that something cannot be transacted. So do her parents and siblings. The same is true for the adult who never reaches old age—as well as for her family, friends, colleagues, and larger community. The marathon runner whose leg is amputated also loses something, even if she ultimately competes in different ways or discovers new perspectives and abilities as a result of that loss. The costs are real even if they are not transactional, and failing to reimburse them does not make them disappear.

Individual crash victims also bear roughly one-quarter of the explicitly economic costs of their crashes. These victims “pay a modest portion of medical care, and absorb significant portions of both market and household productivity losses, as well as property damage.” The unreimbursed costs can be substantial. “Depending on the financial ability and insurance coverage of the individual crash victims,” these costs “can be catastrophic to the victim’s economic wellbeing in addition to their physical and emotional condition.” In a 1999 study of bankruptcy petitioners, one out of four respondents cited illness or injury as a reason for their bankruptcy filing.


102. BLINCOE ET AL., supra note 26, at 238-40.

103. Id. at 238. For more background on these cost estimates, see id. at 38-48.

104. Id. at 8.

Society at large bears the remaining three-quarters of the economic cost.\textsuperscript{106} Private insurers cover 54\% largely by charging policyholders.\textsuperscript{107} People who travel, shop, and breathe pay for 12\% in the form of longer travel times, additional fuel purchases, higher shipping prices, and impacts associated with increased pollution.\textsuperscript{108} Governments at all levels cover 8\% by taxing current and future taxpayers.\textsuperscript{109} In 2010, these economic costs alone came to $784 annually for every person in the United States.\textsuperscript{110}

Nearly every state requires motorists to carry third-party liability insurance (or to otherwise demonstrate financial responsibility),\textsuperscript{111} and many states further require motorists to purchase insurance for injuries caused by uninsured or underinsured motorists.\textsuperscript{112} (In 2012, 12.6\% of motorists were uninsured.)\textsuperscript{113} These required minimums, however, are manifestly inadequate for any serious injury. Most states require coverage of only $25,000 per fatality.\textsuperscript{114} To protect their assets, many drivers carry liability insurance above the legal minimum—but median household net

\begin{footnotesize}
\begin{enumerate}
\item \textsuperscript{106} BLINCOE ET AL., \textit{supra} note 26, at 240.
\item \textit{Id.}
\item \textit{Id.} at 2, 50, 239. $28,027,000,000 / $241,988,000,000 = 11.6\%. \textit{Id.} at 11.
\item \textit{Id.} at 6.
\item \textit{Id.} at 5.
\item \textit{Id.}
\item \textit{Id.}
\item \textit{Id.} In contrast, German law requires at least €1 million in third-party liability coverage for personal injury. BEWACHUNGSVERORDNUNG \textsuperscript{[BEWACHV]} [Regulation on the Security Industry] Haftpflichtversicherung [liability insurance], Oct. 7, 2013, BGBl. I at 1378, § 6 (Ger.); \textit{see also} GESETZ ÜBER DIE Pflichtversicherung für Kraftfahrzeughalter \textsuperscript{[PfVG]} [Law on Compulsory Insurance of Vehicle Owners], Aug. 31, 2015, BGBl. I at 1474, § 4 (Ger.); Walker Smith, \textit{supra} note 16, at 35-36 (advocating a substantial increase in the amount of third-party liability insurance required).
\end{enumerate}
\end{footnotesize}
worth was only $69,000 in 2011.\textsuperscript{115} The average societal cost of a fatality is more than \textit{100 times} these numbers.\textsuperscript{116}

If automated driving reduces the magnitude of crashes, then it should also reduce the societal costs of crashes. A 15\% across-the-board decline in crashes, for example, would reduce annual crash costs by some $125 billion.\textsuperscript{117} Replacing 10,000 fatal injuries with 10,000 minor injuries would reduce costs by some $90 billion.\textsuperscript{118} Even replacing those fatalities with 100,000 minor injuries would still save some $86 billion.\textsuperscript{119}

Once again, there are numerous caveats. Some costly elements of the crash infrastructure, such as trauma centers, may need to exist regardless of how much crashes decline. Because organ donations often come from motor vehicle crash victims, fewer fatal crashes could mean fewer organs donated to others in need.\textsuperscript{120} Vehicles with automated driving systems may be more expensive to repair than conventional vehicles, which could raise the average cost of even minor crashes.\textsuperscript{121} If automated driving increases the number of these minor crashes, the aggregate economic effect could be large. And automated driving could conceivably increase total vehicle miles traveled, which could countervail improvements in per-mile safety.\textsuperscript{122}

Generally, however, most of these issues probably fall into the category of “good problems to have.” Serious motor vehicle crashes dramatically upend lives—often young lives\textsuperscript{123}—in ways that cannot


\textsuperscript{116} See also Walker Smith, supra note 16, at 35.

\textsuperscript{117} See id. at 30-32.

\textsuperscript{118} $90\text{ billion} - $400\text{ million} = $90\text{ billion} \text{ (calculated to one significant figure).}$

\textsuperscript{119} $90\text{ billion} - $4\text{ billion} = $86\text{ billion}.$

\textsuperscript{120} See Justine Hofherr, \textit{What Do Driverless Cars Have to Do With Organ Donors?}, \textsc{Boston.com} (Jan. 23, 2015), https://www.boston.com/cars/news-and-reviews/2015/01/23/what-driverless-cars-have-with-organ-donors/nh5xw0YRrC0X

\textsuperscript{121} See supra discussion at notes 78-80.

\textsuperscript{122} \textit{See supra} discussion at notes 45-58.
be fully expressed in financial terms, even though these are the terms on which this Article is based.

Figure 8 illustrates the potential change in societal crash costs if automated driving substantially increases motor vehicle safety: The pie on the left (representing total crash costs today) is larger than the pie on the right (representing total crash costs if every motor vehicle trip were automated).

**Figure 8**

PRODUCT FAILURE

This section considers those crashes to which the failure of a vehicle or a component thereof contributes. Narrowly construed, this category might include only those crashes in which a vehicle component breaks or malfunctions. More broadly construed, however, this category could include a wide range of suboptimal interactions between a vehicle and the humans who operate, use, or otherwise interact with it.

Although vehicle condition in the narrow sense contributes to crashes, the contribution is far less than that of human error. A 1985 study estimated that vehicle issues are the sole cause of 2% of

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124. For a discussion of human error, see supra note 46 and accompanying text.
crashes and a partial cause of another 10% of crashes.\footnote{125} A NHTSA analysis of the single “last event in the crash causal chain” identified “a vehicle component’s failure or degradation” in 2% of crashes.\footnote{126} This number, however, may not fully account for “internal vehicle related problems that might have led to the crash,” but were not readily apparent to crash investigators.\footnote{127}

The incredible sophistication of modern motor vehicles means that concerns about automotive electronics are not limited to automated driving.\footnote{128} “Electronic systems have become critical to the functioning of the modern automobile.”\footnote{129} These “increasingly interconnected . . . systems are creating opportunities to improve vehicle safety and reliability as well as demands for addressing new system safety and cybersecurity risks.”\footnote{130} In the early 2000s, highly publicized incidents of unintended acceleration in Toyota vehicles prompted widespread speculation about the electronic throttles in these vehicles.\footnote{131} While both NHTSA and NASA ultimately found no evidence of an electronic cause of unintended acceleration in real-world use,\footnote{132} at least one jury may have believed otherwise.\footnote{133}


\footnote{126. SINGH, supra note 44, at 1. The driving environment was the critical reason in 2% of crashes. Id.}

\footnote{127. Id. at 2.}


\footnote{129. SPECIAL REPORT 308, supra note 128 at 2.}

\footnote{130. Id. at 68.}


Even when every component performs as intended, design issues may still contribute to crashes. In these situations, the line between design failure and driver failure is often blurry. For example, NHTSA attributed many instances of unintended acceleration to pedal misapplication by the driver. But even in these cases, a design decision—whether the close placement of the brake and accelerator pedals or merely the traditional placement of these two input devices in a position that is out of sight and operable only by foot—may have contributed to that misapplication. Other design decisions, including the operation of the emergency off switch, may have exacerbated some occurrences of unintended acceleration.

More broadly, design issues related to “human factors” or “human-machine interaction” reflect the fact that humans drive motor vehicles. When a vehicle crashes at 120 miles per hour, excessive speed is likely to be a contributing factor. In general, however, such a speed is reached only because a human decides to drive a vehicle that fast and the vehicle is actually capable of that speed. Similarly, drunk driving generally occurs only when a human decides to drive a vehicle while drunk and that vehicle has no alcohol ignition interlock that would preclude operation by an intoxicated driver. By no means are these examples intended to diminish the driver’s role. Rather, they merely show that many crashes are actually complex products of numerous design and driving decisions.

Regardless, as discussed above, driver error is widely accepted as the key factor in the vast majority of today’s crashes. This is in part because human drivers continue to make almost all of the real-time decisions necessary for driving, from the tactical (such as travel speed) to the operational (such as how to avoid a vehicle swerving into the travel lane). Electronic systems may inform those

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134. TOYOTA ASSESSMENT, supra note 132, at viii.
135. Id. at 52.
136. Id. at 51-52.
137. See id. at 30 n.58.
138. See id. at 66.
139. SAE J3016, supra note 73.
decisions (in the case of blind-spot warnings), implement those decisions (in the case of cruise control), or optimize those decisions (in the case of electronic stability control), but humans remain the drivers for all practical purposes.

In many ways, automated driving systems will essentially drive tomorrow’s vehicles. NHTSA has even suggested as much in the context of the Federal Motor Vehicle Safety Standards (FMVSS). Because these systems will make many if not all of the real-time decisions necessary for driving, it is widely accepted that design issues will play a much greater role in automated driving crashes than in today’s conventional driving crashes.

These systems will eliminate some forms of driver error while introducing new opportunities for other forms of error. These new errors may involve the physical failure of a relevant component, the provision or use of flawed data, a reliance on buggy code, the execution of an unreasonable driving decision, suboptimal interaction among system components, or inadequate communication with other road users, to name just a few. Designing an automated driving system that minimizes, manages, and mitigates these errors is an immense technical challenge.

The complex world in which these systems will eventually operate poses further challenges. Drivers in the United States travel three trillion vehicle miles every year on some four million miles of road. These roads may have potholes, black ice, roadway debris,
crossing animals, falling animals, stalled vehicles, maintenance or construction crews, emergency responders, and wrong-way “ghost drivers,” if not actual ghosts.\textsuperscript{144} Publicly available videos from dashboard-mounted cameras illustrate the wide variety of unusual, dangerous, and tragic situations that human drivers today cause or confront.\textsuperscript{145} Anything that could conceivably happen on the road will eventually happen—as well as many things that cannot be conceived in advance.

Even demonstrating the safety of automated driving may be daunting. The level of safety assurance demanded of aircraft systems would require at least a billion hours of testing.\textsuperscript{146} A statistical comparison between automated and conventional driving could require hundreds of millions of miles of representative driving—and probably much more.\textsuperscript{147} There are many views on, and little consensus about, demonstrating reasonable safety.\textsuperscript{148} I have argued that developers of automated driving systems should have the opportunity and even the obligation to make public safety cases that evidence a lifecycle approach to defining, measuring, monitoring, and ensuring reasonable safety.\textsuperscript{149}

Figure 9 illustrates the increased contribution of product failure to motor vehicle crashes. This figure is based on the initial figure showing crash magnitude. As the pie on the left shows, vehicle failure, as generally conceived, contributes to only a small portion of today’s crashes. As the pie on the right shows, the shift in real-time decision-making from human driver to automated driving system...

\textsuperscript{144} See Nick Kurczewski, Creepy, Cursed, and Curvy: New Jersey’s Clinton Road is the Most Frightening Road in America., N.Y. DAILY NEWS (May 23, 2014, 1:02 PM), http://www.nydailynews.com/autos/creepy-cursed-curvy-new-jersey-clinton-road-frightening-road-america-article-1.1803331 [https://perma.cc/6L6F-6SET].

\textsuperscript{145} See, e.g., YOUTUBE.COM, https://www.youtube.com/results?search_query=dash+cam+compilation [https://perma.cc/L8CU-CLTP] (last visited Nov. 16, 2016) (searching for “dash cam compilation”).


\textsuperscript{147} See Walker Smith, supra note 75; KALRA & PADDOCK, supra note 75, at 2.

\textsuperscript{148} See generally KALRA & PADDOCK, supra note 75.

\textsuperscript{149} Bryant Walker Smith, Regulation and the Risk of Inaction, in AUTONOMES FAHREN 593, 597 (Markus Maurer et al. eds., 2015) [hereinafter Regulation and the Risk of Inaction].
means that vehicle failure is likely to explain a far greater proportion of the crashes that still occur.

**Figure 9**

![Diagram showing comparison between crashes without automation and those with automation]

**INDUSTRY LIABILITY**

The abstract question of “who is responsible in a crash” is as unhelpful as it is popular.150 At the outset, responsibility is not necessarily legal in nature; it can also be moral or technical. Even within the legal domain, responsibility as a concept can contemplate prospective obligations or authorities as well as retrospective liabilities.151 These retrospective liabilities can be criminal, administrative, or civil in nature. Asking who is civilly liable in the event of a crash is therefore more precise—but not necessarily any more helpful.

Courts and legislatures have spent the last century developing, disrupting, and refining the rules of civil liability in the realms of tort, contract, insurance, property, and product liability law. An individual injured in a crash may sue multiple natural or legal persons152 and may ultimately recover from all, some, or none of

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151. *See Regulation and the Risk of Inaction*, supra note 149, at 596.

152. A corporation is a legal person.
them. If a plaintiff successfully recovers damages from a defendant, that defendant may in turn be able to recover some or all of these damages from another natural or legal person. The outcome depends in part on how the specific laws of the particular jurisdiction align with the specific facts of the particular crash.

Insurers play many roles in this process. A crash victim who has automotive, health, or life insurance might seek payment directly from the provider of that insurance. The victim may additionally or alternatively seek payment from an insurer that provides liability coverage to a would-be defendant. In the event of litigation, that insurer may defend its insured and ultimately pay some or all of the costs incurred in that litigation. Any of these insurers may seek to collect some of its costs from another liable party through subrogation of its insured’s claim. Finally, these insurers may themselves rely on a variety of risk-spreading mechanisms, including reinsurance, to which they may turn for recovery. These functions are similar even in states with limited no-fault automotive insurance regimes.153

Largely because of automotive insurance, the vast majority of crashes are handled without any litigation. 154 Accordingly, legal costs represent only 1.3% of total societal crash costs. 155 Even when a lawsuit is filed, it is highly unlikely to proceed all the way to a verdict by a judge or jury. Of the roughly 4,000 motor vehicle personal injury cases that terminated in U.S. district courts in 2015, only 3% actually reached trial.156

Westlaw’s Case Evaluator, which aggregates verdicts from multiple jurisdictions, also points to an absolute decline in the


154. Cf. id. (showing a claim frequency for collision coverage of 5.95 claims per 100 car years).


156. *U.S. District Courts–Civil Cases Terminated, by Nature of Suit, and Action Taken, During the 12-Month Period Ending December 31, 2015* (2015), http://www.uscourts.gov/statistics/table/c-4/statistical-tables-federal-judiciary/2015/12/31 [https://perma.cc/FL5S-JG7M]. This figure includes both cases in which the United States was a defendant and private cases in which there was diversity of citizenship among the parties. Id. Three percent is actually higher than many other kinds of claims. See, e.g., id.; Marc Galanter, *The Vanishing Trial: An Examination of Trials and Related Matters in Federal and State Courts*, 1 J. Empirical Legal Stud. 459 (2004); Xavier Rodriguez, *The Decline of Civil Jury Trials: A Positive Development, Myth, or the End of Justice as We Now Know It?*, 45 St. Mary’s L.J. 333 (2014).
number of verdicts.\footnote{See infra Figure 10.} Figure 10 shows how the number of recorded verdicts in motor vehicle-related negligence claims has fallen since the mid-2000s. Similarly, Figure 11 shows how the number of recorded verdicts in motor vehicle-related product liability claims has declined even more dramatically.\footnote{See infra Figure 11.} Public settlements, which are also shown on the figures, represent only a small portion of all settlements.

\textbf{Figure 10}

![Vehicular negligence verdicts by year](image)

\begin{itemize}
  \item[157.] See infra Figure 10.
  \item[158.] See infra Figure 11.
\end{itemize}
Even settlements and other case dispositions, however, occur against the backdrop of those relatively few cases that do reach a verdict. Those verdicts provide external benchmarks for the standard of reasonable care to which a defendant may be held and the amount of compensation, if any, to which a plaintiff may be entitled. These verdicts also clarify the relevant legal rules, particularly when a losing party appeals to a higher court.

Most personal injury cases involve claims of negligence. This includes 99% of the 80,000 relevant verdicts in Westlaw’s Case Evaluator from 2006 through 2015. The plaintiff asserting a negligence claim must show that the defendant breached a legal duty by acting unreasonably in a way that proximately caused legally recognized harm to the plaintiff. Defendants are frequently individual motorists, and this Article uses the term vehicular negligence to refer to negligence claims against these individuals or

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159. See supra Figure 10.
160. Or, more specifically, that the defendant breached a legal duty by acting unreasonably in a way that proximately caused legally recognized harm to the plaintiff.
their principals. However, defendants may also include manufacturers, sellers, and other companies.

In contrast, defendants in a product liability case are generally the entities that make, distribute, or sell the product or product component that allegedly harmed the plaintiff. In its broad sense (and as used in this Article), product liability law encompasses a variety of claims, including negligence. This area of the law varies tremendously in both time and space: It has evolved dramatically over the last 100 years, and this evolution has produced strikingly different rules in different states. About 6% of the relevant verdicts in Westlaw’s Case Evaluator involve a product liability claim, which is comparable to estimates of the percent of crashes that are caused at least in part by a vehicle failure.

Defect in a legal sense, however, is not necessarily coterminous with failure in a technical sense. The failure or degradation of a vehicle component does not necessarily mean that the component was defective. Vehicles that are reasonably safe when sold may be—and in fact often are—poorly maintained, and they may otherwise reach the end of their functional life. Tire condition, for example, is a particularly obvious factor in some crashes, but a tire is not necessarily defective merely because it explodes. Conversely, a design may be defective even if a component does not physically fail

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161. Under some circumstances, employers and vehicle owners that were not themselves negligent can nonetheless be vicariously liable for the negligent acts of their employees and permissive drivers.
163. See id.
165. Many of these cases also include negligence claims.
166. See infra note 305 and accompanying text.
167. See supra PRODUCT FAILURE (previous Part) (discussing product failure in this technical sense).
169. See SINGH, supra note 44, at 2 (“Of the small percentage (2%) of the crashes in which the critical reason was assigned to the vehicle, [a] tire problem accounted for about 35 percent (±11.4%) of the crashes.”).
or degrade. For example, a plaintiff may allege that she was not adequately instructed on the proper use of a product.\footnote{170}

Crashworthiness claims—also known as enhanced injury or second collision claims\footnote{171}—are an especially important example. Because “[c]ollisions with or without fault of the user are clearly foreseeable by the manufacturer and are statistically inevitable,” that manufacturer has “a duty to use reasonable care in the design of its vehicle to avoid subjecting the user to an unreasonable risk of injury in the event of a collision.”\footnote{172} These claims can involve, for example, the absence of a particular safety device,\footnote{173} a fuel tank fire,\footnote{174} or a second collision between the plaintiff’s body and some part of the vehicle.\footnote{175} Although numbers are not readily available, the attention paid to these claims by practicing attorneys,\footnote{176} high courts,\footnote{177} scholars,\footnote{178} and at least one legislature\footnote{179} suggests they are a significant part of contemporary automotive product liability.

More broadly, the plaintiff in a product liability case must typically demonstrate that she was harmed by a product defect—that is, a dangerous characteristic of a product. If this defect is the result of an imperfect production process, then the plaintiff may be able to recover from the manufacturer even if the production process was


\footnote{172. Larsen v. Gen. Motors Corp., 391 F.2d 495, 502 (8th Cir. 1968).}


\footnote{177. See, e.g., Williamson, 562 U.S. 323; Geier, 529 U.S. 861; D’Amario v. Ford Motor Co., 806 So. 2d 424 (Fla. 2001), superseded by statute, Fla. Stat. § 768.81.


\footnote{179. See, e.g., Fla. S.B. 142, 1st Sess. (Fla. 2011); see also, Larry M. Roth, Florida’s Motor Vehicle Crashworthiness Enhanced Injury Doctrine: “Wanted Dead Or . . . .”, 18 BARRY L. REV. 389 (2013).}
reasonable. However, if this defect is an aspect of the product’s design, then the plaintiff generally must show that the design itself was unreasonable, often by reference to a reasonable alternative design. Similarly, if the defect consists of incorrect or incomplete instructions for or warnings about the product, then the plaintiff must show that the information actually provided was unreasonable.

Proving both that a product was defective and that this defect caused the plaintiff’s injuries can be difficult and expensive, particularly when expert witnesses are required. (Defending such a claim can also be expensive.) These costs can deter injured individuals from pursuing, attorneys from accepting, and parties from fully pursuing claims that are complicated, uncertain, or comparatively low in damages. The combination of litigation expenses and the contingent fee system also means that even successful plaintiffs will only see a portion of the actual settlement or award.

Because they are public, jury awards can provide some insight into how injuries are valued. However, because of post-judgment appeals and settlements, these initial amounts do not necessarily reflect what the plaintiffs are ultimately awarded.

Westlaw’s Case Evaluator provides rough data on awards by claim and injury type. The table below shows data for vehicular negligence and product liability cases involving death, paraplegia, and quadriplegia; significant case variations reduce the utility of

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181. Id. at § 2(b).
182. Id. at § 2(c).
183. See generally Herbert M. Kritzer, Contingency Fee Lawyers as Gatekeepers in the Civil Justice System, 81 Judicature 22 (1997).
185. A 1989 GAO report found that, for the cases examined, appeals and posttrial settlement negotiations resulted in final payments different from the initial verdicts in 30 percent of all cases, and reduced total award amounts by 43 percent. Reductions occurred in 50 percent of the cases won by plaintiffs and in 71 percent of the cases with awards of $1 million or more.

aggregate data on less severe injuries. For each, it indicates the percent of cases in which the verdict favored the defendant, the median award for cases in which the verdict favored the plaintiff, and the median settlement amount in cases in which that amount was publicly disclosed. These awards are generally rounded to one significant figure, because any more specificity would merely mock precision.  

Figure 12

<table>
<thead>
<tr>
<th>Injury, Type, and Theory</th>
<th>Cases in dataset</th>
<th>Defense verdicts</th>
<th>Median public settlement</th>
<th>Median plaintiff verdict</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death - MV Negligence</td>
<td>2670</td>
<td>38%</td>
<td>$400,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>Death - MV Prod Liability</td>
<td>230</td>
<td>64%</td>
<td>$700,000</td>
<td>$5,000,000</td>
</tr>
<tr>
<td>Death - All Prod Liability</td>
<td>738</td>
<td>48%</td>
<td>$400,000</td>
<td>$5,000,000</td>
</tr>
<tr>
<td>Paraplegia - MV Negligence</td>
<td>123</td>
<td>30%</td>
<td>$6,000,000</td>
<td>$9,000,000</td>
</tr>
<tr>
<td>Paraplegia - All Prod Liability</td>
<td>63</td>
<td>72%</td>
<td>$2,000,000</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>Quadriplegia - MV Negligence</td>
<td>102</td>
<td>26%</td>
<td>$3,000,000</td>
<td>$15,000,000</td>
</tr>
<tr>
<td>Quadriplegia - All Prod Liability</td>
<td>91</td>
<td>51%</td>
<td>$3,000,000</td>
<td>$14,000,000</td>
</tr>
<tr>
<td>All injuries - MV Negligence</td>
<td>81842</td>
<td>35%</td>
<td>$50,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>All injuries - MV Prod Liability</td>
<td>4706</td>
<td>53%</td>
<td>$400,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>All injuries - All Prod Liability</td>
<td>1013</td>
<td>59%</td>
<td>$400,000</td>
<td>$3,000,000</td>
</tr>
</tbody>
</table>

Recall that each fatality costs society about $9 million and each critical injury costs society about $6 million.187 (Paraplegia and quadriplegia are particularly critical injuries.) The median public settlements for fatal injuries are an order of magnitude lower than these estimates. The median awards for plaintiff verdicts, while more

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186. These numbers are drawn from a decade of verdicts from a variety of jurisdictions involving a variety of disparate facts. The dataset almost certainly includes some miscoded or otherwise inappropriate cases. To provide a meaningful number of cases, the product liability data used in this Article sometimes relate to all product types rather than to motor vehicles only.

comparable, are not necessarily final. Moreover, these medians exclude all the cases in which the verdict favors the defendant. Whereas most vehicular negligence verdicts in the dataset favor plaintiffs, most product liability verdicts favor defendants. That means that the median award across all product liability claims is actually $0.188.

There are additional differences between the vehicular negligence and product liability awards in the dataset. For those motor-vehicle-related injury cases that do result in a verdict for the plaintiff, the median product liability award is many times higher than the median vehicular negligence award. One explanation for this discrepancy may be the cost of litigating a complex product liability claim, which may discourage plaintiffs (or their attorneys) from fully pursuing these claims for less-than-severe injuries.

The statistical picture with respect to specific injury types is more mixed. For fatal-injury cases with verdicts in favor of the plaintiff, median awards are more than twice as large in product liability as in vehicular negligence; a different analysis by Westlaw’s parent company suggests a similar conclusion albeit with lower numbers. However, for paraplegia and quadriplegia, these awards are comparable between vehicular negligence and product liability. Moreover, median public settlements for paraplegia are actually much higher in vehicular negligence than in product liability.

Characteristics of the defendant may also affect jury verdicts and awards, though both the empirical and the theoretical research on this point are mixed. A 1992 study found that juries are more likely to find for corporate defendants than for individual defendants but also to award somewhat higher damages against those corporate defendants that they do hold liable. This is broadly consistent with the numbers above, although the inclusion of some vehicular negligence cases against corporate defendants may obscure a larger difference. Other empirical investigations of jury behavior have

188. Means are not used here because they tend to be distorted by a few massive awards that either reflect additional injuries or largely comprise punitive damages.

189. See Kritzer, supra note 183.

190. According to Current Award Trends in Personal Injury, the median plaintiff award across all death cases analyzed from 2008 through 2014 is about $900,000, while the equivalent across only product liability cases is $1.9 million. CURRENT AWARD TRENDS IN PERSONAL INJURY 6, 19 (55th ed.).

191. See Brian Ostrom, David Rottman & Roger Hanson, What are Tort Awards Really Like? The Untold Story from the State Courts, 14 L. & Pol’y 77, 95 (1992).
found evidence of a jury preference for individual defendants over corporate defendants.\textsuperscript{192} Juries may distrust companies, sympathize less with these companies, or hold these companies to a higher standard\textsuperscript{193}—or not.\textsuperscript{194} Regardless, the greater perceived wealth of corporate defendants apparently did explain this differential treatment.\textsuperscript{195}

A comparatively wealthy company, however, is more likely to actually be able to pay a large judgment than an individual driver with minimum insurance and minimal reachable assets.\textsuperscript{196} This means that even if a plaintiff prevails against an individual defendant who is uninsured or underinsured, she may not be able to collect in part or in full. In more practical terms, this means that many legally viable claims are never brought solely because they are not financially viable.\textsuperscript{197}

The experience—or at least the rhetoric—of companies that rent or lease motor vehicles also suggests that the aggregate recovery for vehicular negligence would be higher if individual driver defendants had more reachable assets. “In 2005, Congress passed, and the President signed, a multi-billion dollar transportation act that contained the Graves Amendment, which prohibits any state from holding those in the business of renting or leasing cars liable for injuries caused by those cars, absent any negligence on their part.”\textsuperscript{198}

\begin{footnotesize}
\begin{enumerate}
\item[193.] \textit{Id.} at 140-41.
\item[196.] See Gilles, supra note 115, at 606; Huang, supra note 115, at 1034-35.
\item[197.] See Gilles, supra note 115, at 606; see also Walker Smith, supra note 16, at 36 (advocating a substantial increase in the amount of third-party liability insurance required).
\end{enumerate}
\end{footnotesize}
The intent and effect of this provision was to preempt laws in perhaps a dozen states, especially New York, that imposed some form of vicarious liability on these companies for the negligence of the individuals who drove their vehicles. Various industry representatives asserted at the time that this vicarious liability cost car rental companies over $100 million annually in judgments and settlements. In other words, in the states with vicarious liability, these corporate defendants may have paid $100 million annually that likely could not have been collected from the individual negligent drivers.

The discussion so far has focused on the compensatory damages that are intended to make the victim whole. Punitive damages, in contrast, are intended in part to punish the defendant for morally culpable behavior. Analyses of punitive damages reach divergent conclusions about their frequency and size. A study by Westlaw’s parent notes that “punitive damages accompanied compensatory awards in” between 4% and 27% of the cases examined from 2008 through 2014, which is significantly higher


200. See Martin, supra note 198, at 157-58.

201. See 1999 Finance and Hazardous Materials Hearing, supra note 199 (statement of Sharon Faulkner, Area Manager, Premier Car Rental Company). This number was also identified in H.R. 106, which was a precursor to the Graves Amendment. H.R. Rep. No. 106-774, at 5. Another witness suggested that this liability “amounts to over $200 million per year for this industry.” 1999 Finance and Hazardous Materials Hearing, supra note 199, (statement of Raymond T. Wagner, Vice President of Enterprise Rent-A-Car Corp.). Opponents of preemption noted that the “entire industry had only $100 million in accident costs in 1996,” id. (statement of Richard H. Middleton, Jr., President, Ass’n of Trial Lawyers of Am.), although this may have referred only to “collision damages,” id. (statement of Raymond T. Wagner).

202. An opponent of preemption did note that, “the auto rental industry has decided that they are going to not pursue 40 percent of the claims which they could, in fact, pursue for third-party liability. They have made no effort to do so,” though it is not clear from this characterization whether these defendants had assets from which to recover. Id. (statement of Richard H. Middleton, Jr.).

203. See Huang, supra note 115, at 1028, 1035.

204. CURRENT AWARD TRENDS, supra note 190, at 20.
than in vehicular negligence cases (1%) and all cases (between 2% and 5%).\textsuperscript{205} A study of state court cases in 2005, however, found that plaintiffs were awarded punitive damages in only 1% of the product liability cases in which they prevailed.\textsuperscript{206} As a matter of constitutional law, punitive damage awards that are many times higher than the underlying compensatory award engender particular scrutiny from courts.\textsuperscript{207} Like compensatory awards, punitive awards may also be reduced by trial and appeals courts.\textsuperscript{208}

In addition to personal injury, product liability law also encompasses some claims on behalf of purchasers of a product who were economically but not physically harmed, typically because the product fails to conform to explicit or implicit representations made about it by its manufacturer or downstream seller.\textsuperscript{209} In these cases, the harm to each individual purchaser may be small, but the aggregate injury is much more substantial. Because these purchasers are generally similarly situated, they (or an enterprising attorney) may litigate collectively through a class action. For example, in 2013 Toyota agreed to pay over $1 billion to settle a class action alleging that the economic value of vehicles had decreased as a result of sudden unintended acceleration concerns that had undermined Toyota’s claims about safety.\textsuperscript{210}

A more recent (and even more recently dismissed) putative class action alleged that several automakers had known “for years” that their vehicles “have been (and currently are) susceptible to hacking,” that they did not disclose this, and that buyers therefore

\textsuperscript{205}. Id. at 7, 9.


\textsuperscript{208}. See Laura J. Hines & N. William Hines, Constitutional Constraints on Punitive Damages: Clarity, Consistency, and the Outlier Dilemma, 66 HASTINGS L.J. 1257, 1285-86 (2015) (examining 18 product liability opinions, finding a reduction in median punitive damages from about $16 million to $10 million, and noting that these amounts are higher than those found in empirical studies).


paid more than those vehicles are worth.211 In this case, the federal judge concluded that these claims were unsupported by any evidence of personal injury.212 Nonetheless, these claims foreshadow some of the technical and legal issues that could accompany the combination of increasing automation and increasing connectivity.

Scholars have examined the product liability implications of automated driving for more than two decades.213 Broadly, they recognize that shifting the real-time decisions necessary for driving


212. See Hunt, supra note 211.

from human drivers to automated driving systems (or their human designers) means that automotive companies could be liable in a much greater share of crashes involving these systems. These potential defendants could include automotive manufacturers, component suppliers, software providers, data providers, fleet operators, and infrastructure managers, among others that will make up the automated driving industry. (This Article often refers to “manufacturers” or “developers” as synecdoches for this larger set of potential defendants.)

This decisional shift from human driver to automated driving system will significantly increase the importance of product liability relative to vehicular negligence. Whereas today’s crash liability regime is based largely on the liability of individual drivers under negligence, tomorrow’s may be premised on the liability of manufacturers under product liability broadly. This shift will also create new issues for the judges and juries evaluating the resulting crash claims—as well as for the lawyers negotiating to avoid such trials.

Some of these issues will be threshold questions. The software that operates an automated driving system as well as the data used or produced by such a system may or may not be products for the purposes of product liability law. The operator of an automated shuttle fleet may or may not be a common carrier subject to a higher standard of care. Complex business relationships, product interactions, and informational supply chains may lead courts to expand or limit the duties of some potential defendants.

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214. See, e.g., Glancy, Peterson & Graham, supra note 213, at 39 (“[T]he principal locus of liability for accidents is expected to [eventually] transition away from people using these vehicles for transportation and toward the manufacturers of these devices and the software used in them.”).


216. States with no-fault insurance regimes have adopted these regimes against a background rule of negligence. See Glancy, Peterson & Graham, supra note 213, at 11.


Regardless of the particular theories invoked or the particular language used, the argument that the automated driving system in question performed unreasonably will be central to many personal injury claims. This question of unreasonable performance is likely to have two independent prongs: An automated driving system has performed unreasonably if either (a) a human driver or (b) a comparable automated driving system could have done better under the same circumstances.

This first prong—involving a comparison with a human driver—seems to fit most naturally with the consumer expectations test still used by some jurisdictions to determine defect under strict product liability. After all, a consumer is likely to expect that her automated driving system will perform at least as well as she would in any given situation.

This human comparison also matters to the more common risk-utility test. Under this test, a plaintiff may argue that an automated driving system that supplants rather than merely supplements the human driver is unreasonable. For the specific type of crash at issue, the reasonable alternative design would involve human and machine rather than just machine alone. A negligence claim would look similar: The occurrence of a crash that a human driver could have prevented would be used to suggest that the manufacturer acted unreasonably in prematurely marketing an automated driving system that operates without human supervision.

Because manufacturers are likely to imply that their systems are at least as safe as human drivers, a contradictory crash may also give rise to a misrepresentation claim. Many ex ante arguments about safety are likely to be statistical: Crash data, for example, may suggest that automated driving is safer overall than conventional driving.\textsuperscript{220} Although the assumption that automated driving is also safer in every single situation does not logically follow from such a statistical comparison, manufacturers are unlikely to parse this difference in their representations. These representations could also motivate claims on behalf of entire classes of consumers alleging financial rather than physical injury.\textsuperscript{221}

The second prong—involving a comparison with another actual or hypothetical automated driving system—will also focus narrowly on the particular crash at issue. Here, the risk-utility test for strict product liability will ask whether a reasonable change could have

\textsuperscript{220} See BLANCO ET AL., supra note 67, at 40-41.
\textsuperscript{221} See Vlasic, supra note 210.
prevented the injury and not whether the automated driving system is safer than a human driver on the whole. In other words, whether an automated driving system has prevented tens of thousands of injuries in other situations will generally be irrelevant to whether that system caused the one injury in question.

New (and old) issues may arise in applying the risk-utility test to automated driving systems. The cost of a reasonable alternative design that involves changing only a few lines of code may be close to zero. Probabilistic decision-making and machine learning may involve the explicit or implicit weighting of decisional criteria, such as the risk of a crash relative to the risk of a travel delay. A jury may be sympathetic to a plaintiff’s argument that an automated driving system (or its developer) should have assigned even higher values to safety-relevant inputs. Outrage over these values could conceivably motivate some juries to impose punitive damages. At the same time, for probabilistic systems, the plaintiff may struggle to causally connect these values to the actual harm.

A minor crash between one of Google’s research cars and a public bus in February 2016 illustrates these potential challenges. While attempting to merge back into a travel lane, the car “detected the approaching bus, but predicted that it would yield to us because we were ahead of it.” Google’s test driver predicted the same and therefore did not intervene. However, the bus did not yield. Following the crash, Google updated its software so that its “cars will more deeply understand that buses and other large vehicles are less likely to yield to us than other types of vehicles.”

The risk-utility test may also demand even better performance as automated driving technologies improve. For example, consider a

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222. See Proximity-Driven Liability, supra note 213, at 1801.
223. See Walker Smith, supra note 16, at 36-37.
227. Id.
228. Id.
229. Id.
crash at a rural intersection in which the driver of vehicle A carelessly runs a stop sign and strikes vehicle B, seriously injuring its occupants:

**Figure 13**

![Diagram of vehicles A and B at a rural intersection](image)

Under these facts, the driver of vehicle A has clearly acted negligently, and the injured occupants of vehicle B should prevail in a personal injury claim against her. This driver, however, may have minimal liability insurance and minimal assets, in which case the injured occupants would likely be unable to actually collect their full damages. For this reason (and the other reasons noted above), they may look to other potential defendants.

First imagine that vehicle B had a conventional driver. Provided that this driver was behaving responsibly, she is unlikely to face any civil liability. Her vehicle was struck by a careless driver who failed to yield the right of way. She was not negligent, and her fellow occupants would be unlikely to even include her as a defendant, much less successfully recover from her.

But now imagine that vehicle B was operating in a highly automated mode. In this case the injured occupants may argue that
the automated driving system could and should have recognized that vehicle A was not slowing down, predicted that vehicle A would run the stop sign, and taken immediate evasive actions. A jury that would not expect this kind of expert defensive driving from a human driver may nonetheless expect it from an automated driving system.

Such a conclusion might support a finding that the automated driving system was defective. In that case, even if the jury still assigns most of the fault to the driver of vehicle A, the injured plaintiffs might nonetheless collect some or even all of their damages from the manufacturer of vehicle B (or from its relevant suppliers). This is similar to crashworthiness claims today in which automakers may be liable for injuries caused by the unreasonable performance of safety systems in crashes precipitated entirely by driver error. 230

A high-profile fatal crash involving Tesla’s so-called autopilot system is strikingly similar to this hypothetical. 231 In that crash, the driver of a truck pulling a trailer apparently turned across a divided highway, the Tesla car struck the trailer, and the Tesla driver was killed. 232 Potential but-for causes may include, among others, a failure by the truck driver to yield the right of way, a failure by the Tesla driver to brake to avoid striking the trailer, and failures by both the autopilot system and a separate automatic braking system to recognize the trailer as an obstacle. The presence of these two systems has created potential liability for Tesla and its supplier where otherwise there may have been none.

At some point, however, the lack of active safety systems like automatic braking may also give rise to product liability for the manufacturer. Indeed, NHTSA recently announced that major automakers had agreed to make automatic braking standard on their vehicles by 2022; 233 certainly at and possibly even before this point, a jury may conclude that a new vehicle without this feature is defective because of the omission.

It is important to emphasize again that automated emergency intervention systems are conceptually distinct from automated driving systems. 234 This means that the argument that a vehicle

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231. HWY16FH018, supra note 79.
232. Id.
234. See supra notes 17-20 and accompanying text.
should be equipped with automatic braking is different than the argument that a vehicle should be equipped with automated driving functionality. If these were the same, then the liability comparison would be simpler: Given a choice between facing liability for every crash that automation could have prevented and facing liability for only a fraction of such crashes (when that automation actually failed), automakers would rationally choose the latter. However, in any case in which a human driver could have prevented a crash that an automated driving system did not, injured plaintiffs may argue that the combination of human driver and active safety system is a more reasonable design than automated driving without human supervision.

Even so, the complexities of human behavior may actually justify greater automation. Active safety systems that merely support human driving present difficult human factor issues. A human driver who learns that her vehicle’s automatic braking system prevents many common crashes may over-rely on that system. Or a driver may perceive an imminent crash and, in a panic, fight with her vehicle’s automatic emergency steering system in a way that exacerbates the situation. At some point, then, removing the human entirely from active driving may be safer than managing the “mushy middle” of shared human-machine operation.

This shift could also negate product liability claims that a manufacturer did not adequately instruct a driver on how to use an active safety system, misrepresented the performance of that system, failed to guard against foreseeable misuse of that system, or designed that system without reasonably addressing a particular problem with human-machine interaction. Active safety and driver assistance systems that have already reached the market, including crash-imminent braking, may eventually give rise to some of these claims.

Automation could also help automakers reduce their exposure to crashworthiness claims. Avoiding a “first collision” can prevent a “second collision” between the would-be victim and some part of the vehicle. This will not always be the case; for example, a vehicle occupant may still be injured if an automated driving system brakes or maneuvers quickly to avoid a crash. However, if automated

235. See generally Hoenig, supra note 171 (discussing crashworthiness).
236. Id. at 634 n.2.
driving systems operate only when all occupants are belted, then those occupants are less likely to come into contact with other parts of the vehicle even in crashes or other instances of sudden deceleration.

Independent of automation, the increasing connectivity of modern motor vehicles could also give rise to new claims. Automakers and other companies are increasing their “proximity” to their products—through technical means such as remote monitoring, over-the-air updates, and digital rights management technologies as well as legal means such as end user license agreements, subscription agreements, and copyright assertions. With this greater power may come greater responsibility, including expanded tort duties and higher standards of reasonable care. Cybersecurity vulnerabilities may be a particularly important driver of new or expanded post-sale duties to warn or update. Increased data collection may also give rise to obligations and liabilities related to the unauthorized dissemination of those data. However, because these potential sources of liability depend primarily on connectivity rather than automation, they should be included on both sides of a liability comparison.

The mechanics of proving an automated driving-related product liability claim may also differ from the mechanics of proving a vehicular negligence claim or even a contemporary product liability claim. Whether this change favors the plaintiff or defendant in a particular case will depend on the particular facts of the crash and the particular law of the jurisdiction. On one hand, requiring the plaintiff to specifically demonstrate how and why an automated driving system performed poorly and should have performed better could impose technical and financial barriers to many claims, especially those involving comparatively minor injuries. On the other hand, permitting the plaintiff to use the consumer expectations test.


238. See generally Proximity-Driven Liability, supra note 213, 1779-80.

239. See id. at 1779-86.


241. Proximity-Driven Liability, supra note 213, at 1779.

242. See supra notes 219-20 and accompanying text.
the malfunction doctrine, or res ipsa loquitur could make it easier to attribute undesirable outcomes to something within the automated driving system. In that case, the defendant automaker, rather than the plaintiff, might offer a more detailed explanation of the automated driving system’s performance in order to shift some costs to other parties.

Data will be essential to many of these claims. Specific information about the crash may be stored in components of the automated driving system that are on the vehicle, in other systems on board the vehicle, in other vehicles or devices, or in offboard systems accessible to entities that may or may not be party to the case. Collecting, processing, and interpreting these data may be expensive. In some cases, these data provide unprecedented clarity about the actual causes of a particular crash. Indeed, a jury may be able to simply watch a complete recreation of the crash—although such cases would be highly unlikely to actually reach a jury on any question other than damages. In other cases, however, these data could actually produce more ambiguity and argumentation. For example, in one case a defendant automaker argued that its own data event recorder was not reliable—and it won.

Because of all the theoretical and practical considerations discussed in this section, predictions about the effect on aggregate damages are largely speculative. If recovery rates and damage awards remain constant, then a shift from driver liability to product liability would mean that plaintiffs would generally pursue only claims involving significant injuries, that they would recover at a lower rate, and that those who did prevail would receive somewhat higher damages. Eventually, a larger body of settlements would come to reflect these benchmarks trials.

Developers of automated driving systems and automotive insurance companies will play early and important roles in establishing expectations regarding recovery. Some developers may readily recognize instances of clear product failure and quickly

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244. See id. at 280.
246. See Glancy, Peterson & Graham, supra note 213, at 40 (describing stage three of personal injury litigation); Graham, Of Frightened Horses, supra note 213, at 1269-70.
compensate those who suffer physical harm or property damage. (Others may not.247) Automotive insurers, as well as others that cover crash losses,248 will face decisions about how to treat early automated driving claims and, in the event of payment, whether to subrogate those claims against potential defendants.249 Proactive developers and insurers may even partner with each other to fully utilize the existing claims processing infrastructure250 and to capture the savings realized by avoiding product liability litigation.251

Figure 14 illustrates how the role of product liability in compensating the victims of motor vehicle crashes may expand in the future. As the pie on the left shows, motor vehicle manufacturers and associated companies pay only a small proportion of the costs associated with crashes. In the future, however, companies associated with automated driving are likely to be liable for a much greater share of the costs of crashes involving automated driving systems. As discussed previously, however, the hope is that total crash costs will decrease as crash magnitude decreases.252


251. See Kritzer, supra note 183, at 27-28 (describing the high costs of litigation).

252. See supra notes 81-84 and accompanying text.
In short, the companies that develop and deploy automated driving systems are likely to have a bigger slice of what will hopefully be a smaller pie of total crash liability. For the reasons discussed above, this slice could be disproportionately larger than the actual contribution of these systems to crashes, particularly when interactions between automated driving systems and conventional drivers are routine. Figure 15 illustrates this possibility by juxtaposing the pie charts for crash magnitude (Figure 9) and crash cost (Figure 14):
Figure 15

Without automation  With automation?

The smaller pies in the foreground represent crash magnitude (with the darker slices representing product failure),\textsuperscript{253} while the larger pies in the background represent crash costs (with the darker slices representing product liability).

In addition, manufacturers of conventional motor vehicles may eventually incur liability for crashes that are caused by the lack of active safety systems or by the interaction of these systems with human drivers. Figure 16 shows this possibility through the addition of a red slice on the left:

\textsuperscript{253} See supra Parts on Product Failure and Crashes, Injuries, and Fatalities.
As Figure 17 illustrates, it is unclear at this point how total product liability will compare as between conventional and automated driving. A small slice of a big pie (as is the case for conventional driving) may be smaller or larger than a big slice of a small pie (as may be true in the case of automated driving).

As the next section discusses, it is important to distinguish this uncertainty about liability from the actual exposure to liability.
CONSUMER COST

Driving is expensive. The average price of a new motor vehicle today is nearly $35,000. The annual total cost of owning an average is about $0.57 per mile, which is equivalent to $8,600 per year. In comparison, a typical UberX ride in Atlanta might cost $1.13 per mile, which is equivalent to $12,000 per year. The cost of ownership includes average automotive insurance costs of $840 to $1,200. The same survey that produced this lower figure found average annual expenditures of $520 on third-party liability coverage and $300 on collision coverage.

The price of automated driving products and services will reflect the product liability exposure of that industry. An extremely rough estimation exercise can offer an order-of-magnitude sense of this added cost in the United States. The exercise explicitly (and crudely) assumes that:


258. Auto Insurance, supra note 153.

259. AAA Driving Costs 2016, supra note 255.

Developers, manufacturers, suppliers, and operators of automated driving systems pay 54% of total societal crash costs. (Insurers currently cover 54% of the $242 billion in economic costs.261 Using total costs rather than just economic costs allows for the possibility that crash victims and the entities that insure them will recover far more of their damages, particularly for pain and suffering, in a product liability-based regime than in the current vehicular negligence-based regime.)

These costs would equal $975 billion annually without automated driving. (This higher figure262 represents a rough attempt to account for the increase in crash deaths263 and the change in the value of a dollar between 2010 and 2015.264)

Legal expenses continue to account for only 1.3% of these costs.265 (In other words, recovery through a product liability-based regime is no more expensive than recovery through a vehicular negligence-based regime.)

Automakers sell 17,500,000 light-duty vehicles annually,266 100% of which have permanently engaged automated driving systems.267 (In other words, vehicle sales do not change even if most vehicles are sold or transferred to fleets rather than to individuals.)

There are 260,000,000 total registered vehicles,268 100% of which have permanently engaged automated driving

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261. BLINCOE ET AL., supra note 26, at 1, 13.
262. See supra discussion at note 103.
263. There were about 7% more crash deaths in 2015 than in 2010. See supra note 55 and accompanying text.
265. BLINCOE ET AL., supra note 26, at 16.
267. See supra INTRODUCTION.
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systems.269 (In other words, the total fleet size does not change.)

(6) These vehicles travel 3.15 trillion vehicle miles annually,270 which is equivalent to 11,300 miles per light-duty vehicle.271 (In other words, total vehicle miles traveled do not change.)

(7) These assumptions are independent of the business models identified below.

These assumptions are extremely rough and subject to significant criticism. The assignment of 54% of total societal crash costs to automotive companies, for example, is essentially arbitrary. Moreover, if only economic costs were used rather than total societal costs, the resulting cost estimates would be just one third as large. However, the larger numbers are used to reflect the possibility of greater compensation under a product liability-based regime.272

The exercise further posits four safety scenarios:

(1) Baseline: Automated driving does not reduce total crash costs.

(2) Moderate: Automated driving reduces total crash costs by 20%.

(3) Ambitious: Automated driving reduces total crash costs by 50%.

(4) Exceptional: Automated driving reduces total crash costs by 80%.

Finally, this exercise identifies four potential business models:

(1) Sale: A manufacturer sells its vehicles at a price that covers all of the liability costs that it incurs that year. (In other words, the manufacturer relies on new sales to cover existing liabilities.)

(2) Lease: A manufacturer leases its vehicles at a price that, over five years, covers all of the liability costs that it incurs that first year.273

269. See supra INTRODUCTION.
270. See 2015 TRAFFIC VOLUME TRENDS, supra note 78.
271. AAA uses 15,000 miles per vehicle per year. AAA Driving Costs 2016, supra note 255.
272. See supra notes 186, 190 and accompanying text.
273. The average lease term is about thirty-six months, and the average loan term is about sixty-seven months. See Melinda Zabritski, State of the Automotive Finance Market: First Quarter 2015, EXPERIEN, at 13, 27 (2015), https://
(3) Subscription: A manufacturer makes its automated driving system available to users for a monthly or yearly fee that covers all of the liability costs that it incurs over that period.\footnote{274.}  

(4) Service: A manufacturer makes its vehicles available to users for a charge per vehicle mile traveled (VMT) that covers all of the liability costs that it incurs over that mile.\footnote{275.}

Figure 18 shows the rough resulting product liability cost estimates for these four models.

<table>
<thead>
<tr>
<th>Model</th>
<th>Unit</th>
<th>Baseline (-0%)</th>
<th>Moderate (-20%)</th>
<th>Ambitious (-50%)</th>
<th>Exceptional (-80%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale</td>
<td>Per vehicle sold</td>
<td>$30,000</td>
<td>$24,000</td>
<td>$15,000</td>
<td>$6,000</td>
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<tr>
<td>Lease</td>
<td>Per vehicle per year for 5 years</td>
<td>$7,000</td>
<td>$5,500</td>
<td>$3,500</td>
<td>$1,400</td>
</tr>
<tr>
<td>Subscription</td>
<td>Per vehicle per year</td>
<td>$2,000</td>
<td>$1,600</td>
<td>$1,000</td>
<td>$400</td>
</tr>
<tr>
<td>Service</td>
<td>Per year (based on VMT)</td>
<td>$1,900</td>
<td>$1,500</td>
<td>$950</td>
<td>$380</td>
</tr>
<tr>
<td></td>
<td>Per VMT</td>
<td>$0.17</td>
<td>$0.13</td>
<td>$0.08</td>
<td>$0.03</td>
</tr>
</tbody>
</table>

Many of these numbers are large, but not extraordinarily so. Under the ambitious safety scenario, the product liability costs range from about 11% of annual vehicle ownership costs (with the service

\footnote{www.experian.com/assets/automotive/white-papers/experian-auto-2015-q1.pdf [https://perma.cc/7ZTU-GT4U].

274. See, e.g., Proximity-Driven Liability, supra note 213, at 1817.

275. See id.
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model) to about 40% of annual vehicle ownership costs (with the lease model).276

The numbers appear most dramatic for the sales model, because that model spreads hundreds of billions of dollars of crash costs among the relatively few consumers who purchase a new vehicle in any given year. The lease model also spreads these costs among new vehicle buyers, but it reflects the reality that the vast majority of these buyers actually rely on financing, including both loans and leases.277 Incidentally, automakers already tend to rely at least in part on the sale of their new vehicles to cover the liability costs associated with their old vehicles,278 which means that liability and other legacy costs related to vehicles sold years prior could conceivably disadvantage these companies as they compete with new entrants to the automotive or transportation markets.279

The subscription and service models further spread these costs, and, because of the assumptions used, are roughly equivalent. If automated driving enables current trips to be serviced by fewer total

276. See AAA Driving Costs 2016, supra note 255. AAA’s annual vehicle costs assume 15,000 miles per vehicle per year, id., which is somewhat higher than the 11,300 miles per year used for the annual cost of the service model.

277. See Zabritski, supra note 273, at 6-7. Nearly 85% of new vehicle purchases in the first quarter of 2015 involved financing. Id. at 6.

278. Compare, e.g., Ford Motor Co., Annual Report (Form 10-K), at FS-70 (Feb. 3, 2015), https://corporate.ford.com/microsites/sustainability-report-2014-15/doc/sr14-form-10-k.pdf [https://perma.cc/6CPR-YBMR] (“We accrue for [litigation] matters when losses are deemed probable and reasonably estimable . . . [taking] into consideration factors such as our historical experience with matters of a similar nature, the specific facts and circumstances asserted, the likelihood that we will prevail, and the severity of any potential loss. We reevaluate and update our accruals as matters progress over time. For the majority of matters, which generally arise out of alleged defects in our products, we establish an accrual based on our extensive historical experience with similar matters.”), with id. at FS-71 (“We accrue obligations for warranty costs and field service actions (i.e., safety recalls, emission recalls, and other product campaigns) at the time of sale. We establish estimates for warranty and field service action obligations using a patterned estimation model using historical information regarding the nature, frequency, and average cost of claims for each vehicle line by model year.”).

Then the per-vehicle cost of the subscription model may be higher than estimated. Unlike that model, the service model can charge liability costs to each vehicle mile traveled, and the charge for a particular mile could even reflect the crash risk of that mile.

When the average annual expenditure for automotive liability insurance is subtracted from the estimates in Figure 18, these numbers become even more interesting. In 2013, this expenditure was about $520 per vehicle. Figure 19 shows the resulting estimates. (The upfront cost of the pure sale model, which is essentially unchanged, does not reflect the present value of the lifetime insurance savings.)

<table>
<thead>
<tr>
<th>Model</th>
<th>Baseline (-0%)</th>
<th>Moderate (-20%)</th>
<th>Ambitious (-50%)</th>
<th>Exceptional (-80%)</th>
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<td>$3,000</td>
<td>$900</td>
</tr>
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<td>Subscription</td>
<td>$1,500</td>
<td>$1,100</td>
<td>$500</td>
<td>($100)</td>
</tr>
<tr>
<td>Service</td>
<td>$1,400</td>
<td>$1,000</td>
<td>$400</td>
<td>($150)</td>
</tr>
<tr>
<td></td>
<td>$0.12</td>
<td>$0.09</td>
<td>$0.04</td>
<td>($0.01)</td>
</tr>
</tbody>
</table>

Under the ambitious safety scenario, the product liability costs range from about 5% of annual vehicle ownership costs (with the service model) to about 34% of annual vehicle ownership costs (with the lease model). Strikingly, under the exceptional safety scenario, the subscription and service models may even produce a net cost saving.

Automated driving may have other benefits that reduce its cost relative to conventional driving. A particularly significant example relates to the value of time. If automated driving allows vehicle users to reallocate 80% of their travel time at $18 per hour, these users


could potentially “save” $4,000 per year, which is equivalent to $0.38 per mile. The potential consumer savings are much more tangible in the case of an automated taxi or ridesharing system. Recall that a typical UberX ride in Atlanta might cost $1.13 per mile. An UberX driver might earn about 75% of this fare. This means that automating that driver’s job could result in a cost savings of $0.85 per mile.

These additional consumer savings (as well as any additional consumer costs) are relevant to the practical impact of product liability but not to the theoretical impact of product liability. If these savings are significant, then automated driving could be cheaper and hence more attractive than conventional driving even if product liability costs are higher. In that case, however, automated driving would be even cheaper and hence even more attractive without those higher liability costs. From a safety perspective, this may be an important distinction.

Of course, all of these numbers are incredibly rough estimates, and the actual consumer costs of product liability could be many times higher or lower. This uncertainty provides another argument for the subscription and service models. As the developer of an automated driving system learns more about the technical performance and liability implications of that system, it can adjust [2014 dollars); Memorandum from Carlos Monje, Assistant Secretary for Transportation Policy, to Secretarial Officers & Modal Administrators (2015), at tbl. 4. https://www.transportation.gov/sites/dot.gov/files/docs/Revised%20Departmental%20Guidance%20on%20Valuation%20of%20Travel%20Time%20in%20Economic%20Analysis.pdf [https://perma.cc/AYA3-8KMB] (recommending values ranging from $12.50 per person-hour for local personal automotive travel to $24.40 for business automotive travel of any type in 2013 dollars).

283. “On average, Americans drive 29.2 miles per day [or 10,658 miles per year], making two trips with an average total duration of 46 minutes.” AAA Study, supra note 256. 46 minutes/day * 365 days * 80% * $18/hour = $4,029.60.

284. $4,029.60 / 10,658 miles/year = $0.37808/mile.

285. Atlanta Uber Prices, supra note 256 (noting fees of about $2 and charges of $0.12 per minute and $0.75 per mile). The calculation assumes a ten-mile trip that lasts fifteen minutes for an average speed of 40 miles per hour. Cf. AAA Study, supra note 256 (“On average, Americans drive 29.2 miles per day, making two trips with an average total duration of 46 minutes.”). $2 + (0.75 * 10) + (0.12 * 15) / 10 = $1.13 per mile.


287. $1.13/mile * 75% = $0.8475. Of course, this also means that this driver will have lost her job.
what it charges per month or per mile. In this way, uncertainty need not mean inaction.

Several key companies—including traditional automakers like Ford and General Motors—are already pursuing the service model. Reasons for this may include a desire for more control over the automated driving systems, greater price flexibility, lower perceived consumer cost, and increased access to the users. The service model, particularly its per-mile cost, is the focus of the remaining analysis.

CONSUMER ADOPTION

This section considers the impact of a shift from a driver negligence-based personal injury regime to a product liability-based personal injury regime on consumer adoption of automated driving systems. To the extent that automated driving is safer than conventional driving, this adoption will presumably advance the societal goal of safety.

At the outset, it is important to recognize that compensation is also a societal goal that could be affected by automated driving. As summarized earlier, this regime shift might mean that plaintiffs would generally pursue only claims involving significant injuries, that they would recover at a lower rate, and that those who did prevail would receive somewhat higher damages.

The question explored here, however, is whether product liability exposure or uncertainty could delay or diminish widespread adoption of automated driving systems. There are at least three steps to this adoption: Companies need to develop and then market these systems, after which consumers to buy or otherwise use them.

Dire predictions that product liability will thwart innovation should—and can—be put in perspective. In 1993, the Federal

288. See Proximity-Driven Liability, supra note 213, at 1817-19.

289. Id.


291. See supra notes 59-61 and accompanying text.

292. See supra notes 188-89 and accompanying text.
Highway Administration commissioned a report on tort liability faced by developers of “advanced vehicle control systems” (AVCS). The report concluded that “[t]he prospect of liability for catastrophic accidents resulting from a failure of AVCS will likely deter entities from becoming involved with AVCS and impede its development unless the federal government adopts some or all of the legislative” limits on liability discussed in the report. These limits ranged from restricting damages to eliminating some or even all tort claims.

At the time, the prediction that product liability would deter companies from releasing advanced driver assistance systems and from researching even more advanced forms of driving automation was understandable—and difficult to disprove. In the intervening two decades, however, traditional automotive manufacturers have widely released many of these systems, while they and others have invested heavily in automated driving. These companies have done so without receiving special exemptions from the generally applicable product liability regimes of each state. (Product liability law has changed over the last two decades, including in many ways more favorable to product sellers. However, few of these changes are as dramatic as the liability limitations discussed in the 1993 report.)

In other words, remarkable innovation in the automotive industry seems to have refuted this prediction. Moreover, because of the tremendous progress in automated driving, the assertion that

293. ROBERTS ET AL., supra note 213, at 1.
294. Id. at 57.
295. Id. at 48-57.
296. Notably, the 1990s were a peak of the “tort reform” movement. See, e.g., F. Patrick Hubbard, The Nature and Impact of the “Tort Reform” Movement, 35 HOFSTRA L. REV. 437, 469-70 (2006); John T. Nockleby & Shannon Curreri, 100 Years of Conflict: The Past and Future of Tort Retrenchment, 38 LOY. L.A. L. REV. 1021, 1022 (2005) (“The 1994 Republican ‘Contract with America’ promised Americans that, if Republicans took control of Congress, one of ten key agenda items would be changing the civil justice system.”).
299. See, e.g., supra notes 204-06 and accompanying text (discussing punitive damages).
300. See generally ROBERTS ET AL., supra note 213.
liability will deter the introduction of highly automated driving systems can be tested in a way that was not possible twenty years ago: If a developer of such a system is reluctant to release it, that developer can simply point to its production-ready system and promise to release it if and only if particular rules of liability are changed.

Rather than demand such changes, several prominent companies have publicly “accepted” current product liability law. Volvo Cars has stated in a press release that it “will accept full liability whenever one of its cars is in autonomous mode.” Google and Daimler have both accepted that they will be liable if their respective technologies are at fault. These statements are not revolutionary declarations as much as they simple acknowledgements of existing law. They also do not necessarily resolve difficult questions of fault, causation, and damages. And to the extent that these statements function as product representations, they also raise a fascinating product liability question in their own right. Regardless, such acknowledgments implicitly refute the notion that current product liability law is an absolute bar to automated driving.

The experience—or merely the continued existence—of the larger transportation industry is also instructive. In tort law, a person who causes a crash by negligently driving a vehicle is generally liable to the victim of that crash. Under some circumstances, however, the employer of that driver or the owner of that vehicle may also be vicariously liable to the victim even if the driver was the


303. These companies are essentially saying that they will be liable when they are liable. Future plaintiffs may disagree with these companies, however, on the specifics of the particular incident, including the meaning of defect, the existence of causation, and the extent of damages. See infra notes 307-10 and accompanying text.

304. In short: Might a consumer purchase or use an automated driving system in reliance on a promise by the developer that it will assume liability in the event of a crash? If so, the developer’s refusal to promptly compensate a crash victim might give rise to an argument of equitable estoppel and a separate claim for misrepresentation—by the crash victim and, conceivably, the entire class of buyers.
only negligent actor. This vicarious liability is at least as “strict” as product liability.

As noted earlier, the automotive leasing and rental industry successfully sought federal preemption of their vicarious liability for the negligence of individuals driving those vehicles. At the time, this industry characterized vicarious liability as an existential threat—one which “has put literally hundreds of small operators out of business in States such as New York and other States across the country.” This argument seems extreme: A decade earlier, one major rental company noted that its cost for all liability settlements, including those for vicarious liability, “amounted to 8 to 11 percent of [its] annual revenues in the last few years,” which is comparable to what the average motorist pays for liability insurance as a percentage of the total cost of vehicle ownership.

Vicarious liability persists in other contexts. Notwithstanding the Graves Amendment, motor carriers and taxicab companies and one major rental company noted that its cost for all liability settlements, including those for vicarious liability, “amounted to 8 to 11 percent of [its] annual revenues in the last few years,” which is comparable to what the average motorist pays for liability insurance as a percentage of the total cost of vehicle ownership.

Vicarious liability persists in other contexts. Notwithstanding the Graves Amendment, motor carriers and taxicab companies

305. The employer or vehicle owner can also be liable for negligently maintaining the vehicle or negligently entrusting it to the driver. In these cases, however, the employer or vehicle owner is actually negligent itself.


309. Matthew L. Wald, Further Limits on Car Renters, N.Y. Times (July 11, 1992), http://www.nytimes.com/1992/07/11/business/further-limits-on-car-renters.html [https://perma.cc/T9XG-HWKB]. In a potential victory for safety, vicarious liability had apparently also persuaded that company to ask its renters if they had been convicted of drunk driving before giving them the keys. Id.


311. 49 U.S.C. § 30106 (2012) (“An owner of a motor vehicle that rents or leases the vehicle to a person (or an affiliate of the owner) shall not be liable under the law of any State or political subdivision thereof, by reason of being the owner of the vehicle (or an affiliate of the owner), for harm to persons or property that results or arises out of the use, operation, or possession of the vehicle during the period of the rental or lease, if—(1) the owner (or an affiliate of the owner) is engaged in the trade or business of renting or leasing motor vehicles; and (2) there is no negligence
can be liable for the negligence of the drivers to whom they lease their equipment. Delivery companies can also be liable for the negligence of their drivers\textsuperscript{314}—or even their lessors’ drivers.\textsuperscript{315} As a general matter, companies are liable for the negligence of their employees while acting within the scope of employment.\textsuperscript{316} The questions of who is an employee\textsuperscript{317} and what is within the scope of employment\textsuperscript{318} can require fact-specific determinations, and courts may reach different conclusions.

For companies that are in the business of using public roads, vicarious liability for the crashes negligently caused by their drivers is often part of that business. They pass the cost of this liability onto their customers through the prices charged for rides or packages or pizzas. Nonetheless, people continue to buy rides, packages, and pizzas.

A service model for automated driving would likewise pass the costs of product liability onto the users of that automated driving service. Recall that, for the ambitious safety scenario (which assumes a 50% reduction in crash costs), the resulting product liability cost was very roughly estimated at between four and eight cents per mile.\textsuperscript{319}

Fuel prices provide another point of reference for liability costs under the service model. Figure 20 shows that the fuel cost to travel one mile has, when adjusted for both inflation and changes in
average fuel economy, varied between eight cents and eighteen cents since 1990.320

Figure 20

Even if this price variation affects other spending decisions, it seems to have had little effect on vehicle miles actually traveled.321 Figure 21 shows the relationship between real fuel cost and VMT per capita on an annual basis between 1990 and 2015.322


This comparison both requires and contains some caution. The choice between traveling and not traveling is different from the choice between driving and riding: An employee who needs to commute to her office probably does not need to do so in an automated taxi. Furthermore, swings in the price of fuel hardly go unnoticed, and an increase in the cost of travel of eight cents per mile (before any offsetting savings) is equivalent to a rise of about $1.70 in the price of gasoline. But this has precedent: It is roughly what occurred between 2002 and 2008.

Again, the consumer costs under all four business models are large, but not extraordinarily so. And that is an important point. This exercise suggests that large—but not extraordinarily large—charges might directly cover more than 50% of total societal crash costs. In a hypothetical world with only automated driving, a charge of pennies...
per mile might reimburse losses twice as large as those covered by the entire automotive insurance industry in 2010.326

CONCLUSION

The foregoing analysis suggests that automated driving and product liability can coexist. In comparison to the automotive industry today, the automated driving industry will likely bear a bigger slice of a smaller pie of total crash costs. Given substantial uncertainty about the size of that slice, this industry may be inclined toward service-based business models that provide more flexibility. Under such a model, liability exposure could conceivably add several cents per mile to travel costs.

This analysis is a sketch that should be refined as automated driving becomes real and, ultimately, routine. As companies move their automated driving systems closer to deployment, they will learn more about the actual performance of those systems both in absolute terms and relative to human drivers. As automotive insurers negotiate with manufacturers over subrogated claims involving advanced driver assistance systems, both sides will learn more about expected litigation and settlement costs. In many cases, unfortunately, this information will not reach the public.327

One entity is particularly well positioned to contribute to public analysis of these questions. With 215,000 vehicles328 traveling over 1.2 billion miles annually,329 the United States Postal Service (USPS) operates “one of the largest civilian fleets in the world.”330 A USPS employee who is injured on the job generally obtains workers compensation under the Federal Employees’ Compensation Act.331


327. Greater transparency in other domains would also be useful to understanding these issues. High-speed electronic trading, for example, could already offer valuable insight into the legal, technical, and business strategies that companies use to manage massive financial risks associated with automated systems that operate in complex environments at speeds that preclude effective human supervision.


330. SIZE AND SCOPE, supra note 328.

and a member of the public who is injured by the on-the-job negligence of one of those 625,000 employees\(^{332}\) generally obtains compensation under the Federal Tort Claims Act.\(^{333}\) Just as USPS’s vast logistics operation could provide insight into the driving environment, its legal operation could provide insight into personal injury negotiations and settlements. Although USPS is authorized to withhold its attorneys’ work product under the Freedom of Information Act,\(^ {334}\) that statute does not obligate it to do so.\(^ {335}\)

A clearer public understanding of the state of personal injury litigation may be instructive for other cyberphysical systems as well. Roadways are far from the only imperfect environment. In addition to the 35,000 roadway fatalities, each year there are some 5,000 deaths from workplace injuries,\(^ {336}\) 20,000 deaths from home injuries,\(^ {337}\) and somewhere between 100,000 and 440,000 deaths from medical errors.\(^ {338}\) In 2014, unintentional poisonings killed 42,000 people, unintentional falls killed 32,000 people, homicide by firearm killed nearly 11,000 people, and suicide by firearm killed nearly twice that number.\(^ {339}\)

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334. 5 U.S.C. § 552(b)(5) (1994) (“[I]nter-agency or intra-agency memorandums or letters which would not be available by law to a party other than an agency in litigation with the agency . . . “); see also 110 Am. Jur. Trials 367 § 21 (2008).


Whereas deaths and injuries can be recorded and tracked, the panoply of unmet needs in society is harder to inventory. From sustenance and survival\textsuperscript{340} to care and companionship,\textsuperscript{341} many people need more. Beyond basic needs, opportunities for (at least arguable) improvement also abound. From the body to the home to the sky, cyberphysical systems may address or affect these needs and opportunities.\textsuperscript{342} Even some of the 74 million housecats in the United States\textsuperscript{343} may be able to look forward to food,\textsuperscript{344} water,\textsuperscript{345} litter,\textsuperscript{346} medical monitoring,\textsuperscript{347} and entertainment\textsuperscript{348} on demand.

In contrast to automated driving systems, the safety argument for some of these cyberphysical systems may be more difficult to discern—if there is one. Small unmanned aerial vehicles, for example, are not a replacement for particularly dangerous humans with wings. But they might substitute for light aircrafts,\textsuperscript{349} motor


\textsuperscript{341}. See \textit{Selected Long-Term Care Statistics}, \textit{Family Caregiver Alliance} (Jan. 31, 2015), \url{https://www.caregiver.org/selected-long-term-care-statistics} [https://perma.cc/FPY6-G9U5]; see also Janice Shaw Crouse, \textit{The Loneliness of American Society}, \textit{Am. Spectator} (May 18, 2014, 8:00 AM), \url{http://spectator.org/59230-loneliness-american-society} [https://perma.cc/YNK7-DUXA].


\textsuperscript{344}. See Petnet, \url{http://www.petnet.io} [https://perma.cc/5AUM-THUD] (last visited Nov. 16, 2016).


\textsuperscript{348}. See Mousr, Petronics, \url{http://www.petronics.io/#landing} [https://perma.cc/637P-CHNS] (last visited Nov. 16, 2016).

vehicles—350 or ladders351—all of which do pose dangers. Identifying appropriate analytic boundaries352 is an important step toward understanding product liability’s effects on the societal costs and benefits of a particular technology.

Like the world in which it operates, product liability law is far from perfect. These imperfections could advantage or disadvantage new technologies vis-à-vis their conventional counterparts. And these technologies, in turn, could mitigate or exacerbate those imperfections. These are problems to be explored.

Those who conclude that these are also problems to be solved should proceed deliberately. They should assess whether the underlying challenges relate to liability exposure or to liability uncertainty; distinguish between reducing the costs of injury and merely shifting those costs; identify the negative externalities of today’s systems before assuming the positive externalities of tomorrow’s systems; and be wary of inadvertently placing new technologies on one side of old battle lines. Long after automated driving is a reality, these are the kinds of issues that humans will still be navigating.


352. See Lawyers and Engineers Should Speak the Same Robot Language, supra note 54, at 78.
III. Law, Virtual Reality, and Augmented Reality

LAW, VIRTUAL REALITY, AND AUGMENTED REALITY
Mark A. Lemley* & Eugene Volokh**

INTRODUCTION

In the summer of 2016, the world suddenly went crazy for Pokemon GO. Millions of people were traveling to spaces public and private to catch, train, and fight with monsters that only they could see. As the mania spread, cities and parks held Pokemon GO parties.1 Hospitals and the Holocaust Museum put up signs warning players that there were no Pokemon to be found on the premises.2 At least one police station politely asked people who came to the police station to catch Pokemon to do so outside the building rather than coming in to bother their officers.3

Gamers and those with a nostalgia for the Pokemon card game loved the Pokemon GO phenomenon. People whose property was invaded by dozens or hundreds of Pokemon GO players hated it, or adapted to it, or tried to make money from it.4 Many other people were puzzled by it. And us? We’re law professors, so naturally our first thought was “just imagine how many potential legal questions this raises!” That’s why lawyers are so much fun at cocktail parties.

Pokemon GO was the first exposure most of the world had to augmented reality (AR). AR allows digital content to be layered over the real world. Using special glasses or, more commonly for now, a smartphone, AR users can see the real world as it actually exists, but with digital images superimposed on the world so that they seem to exist as part of the world. And while gaming is the first application to reach the mass market, it won’t be the last. Our experience of the real

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world will increasingly be overlaid with information and images—sometimes related to what we physically see, sometimes not.

Beyond AR, there is also virtual reality (VR). While AR adds visible digital content to a person’s perception of the real world, VR replaces the real world altogether. Using goggles and speakers, VR places people inside a virtual environment, letting them move around in it and interact with it as if it were the real world.

In some ways, VR is a competitor technology to AR: Business meetings and social interactions with remote parties could happen either via VR or AR, depending on which technology evolves most quickly. In other ways, VR can be complementary, with people using AR technology for adding to physical-world interactions, and VR for creating entirely fictional worlds.

VR also got big in 2016. Four major VR hardware platforms were deployed; so were many applications—mostly games, but also immersive news reporting and social experiments. And the technology, already impressive in its realism, continues to develop at a breakneck pace. While most applications of VR today remain games, it won’t be long before more and more of our interactions occur in virtual rather than real space (especially as avatars become realistic enough, and begin to reliably track user facial expressions).

AR and VR both present legal questions for courts, companies, and users. Some are new takes on classic legal questions. People will die using AR and VR—indeed, some already have. They will injure themselves and others. Some will use the technology to threaten or defraud others.

Sorting out who is responsible will require courts to understand the technology and how it differs from the world that came before. But it won’t necessarily require a fundamental rethinking of legal doctrines. A death threat via AR or VR is legally the same as a death threat via an oral conversation, a letter, an e-mail, or a fax.

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7 Because VR- and AR-mediated conversations are more likely to be recorded, the VR/AR threat may be easier to prove than an oral threat; but in that respect, the VR/AR threat would be much like a threatening letter.
But AR and VR will also create new legal questions. Virtual interactions will be conducted through devices and networks that are privately owned and operated. Those interactions may therefore be subject to contractual terms and conditions that users will likely never see or consider, but that significantly limit the privacy, property, and liberty rights of those users.

The interactions may not happen in any one physical jurisdiction, and therefore may be harder to regulate effectively. This move—from conducting most of our business in public spaces with public rules, largely located in a single jurisdiction, to private spaces with private rules in which the parties seem next to each other but are really physically in many jurisdictions—may cause us to rethink just what constitutes a legally binding contract and what things we want governed by public rather than private rules.

And AR and VR can also raise other questions that are more fundamental. VR isn’t “real” in the way we normally mean that term. It is an artificial construct, bits cobbled together to produce sounds and images that we observe. But it feels real in a way that is hard to understand until you’ve experienced it. The same may be true with AR, if it can overlay vivid and realistic images of people and objects over the real reality that we see.

This gut feeling of realness can cast doubt on legal doctrines that tend to distinguish between physical contact and physical danger and things that are “just” audio and visual communication. We base many rules on the distinction between the mental and the visceral, between things we perceive and things we experience. VR and AR will make it harder to draw that line, and may push us to think hard about why we punish certain kinds of conduct and not others in the physical world. Indeed, they may even lead us to rethink the notion of what is “real” in a world where more and more of our most significant experiences aren’t “real” in the classic understanding of that term.

VR and AR aren’t the first technologies to challenge legal doctrine. We can, for instance, learn some important lessons from our efforts to apply legal rules to the Internet over the past quarter century. But most of those efforts happened haphazardly, not deliberately. Thinking deeply now about how the law will apply to VR and AR requires us to tread new ground. The reward—hopefully—will be not only a solid framework for applying legal doctrine to some tricky new questions, but also a better understanding of doctrines we take for granted in the physical world.

We begin in Part I, by discussing the rise of VR and AR and how people experience those technologies. We then turn in Part II to how the law is likely to treat “street crimes” in VR—behavior such as disturbing the peace, indecent exposure, deliberately harmful visuals (such as strobe lighting used to provoke seizures in people with epilepsy), and
“virtual groping.” Two key aspects of this, we will argue, are the Bangladeshi problem (which will make criminal law very hard to practically enforce) and technologically enabled self-help (which will offer an attractive alternative, but also a further excuse for real-world police departments not to get involved).

In Part III, we turn to tort lawsuits, by users against users, users against VR and AR environment operators, outsiders (such as copyright owners whose works are being copied by users) against users, and outsiders against the environment operators. In Part IV, we discuss users’ alteration of other users’ avatars, or creation of their own avatars that borrow someone else’s name and likeness, and discuss whether that should be viewed as tortious.

We then consider in Part V the likelihood that VR and AR systems will pervasively store all the sensory information that they present to their users (and that they gather in the course of presenting it), and discuss the privacy implications of such data collection and potential disclosure. And we close in Part VI by talking about two overarching issues—order without law and the speech-conduct distinction—that can reflect on broader debates even outside VR and AR.

Our article primarily aims to identify the interesting coming questions, and outline some possible answers. We will sometimes suggest which answers are best, but that’s not the main value that we seek to add. Rather, we simply hope that, by thinking ahead about such matters, all of us can better decide how to better develop both VR and AR law and VR and AR technology, and perhaps also learn something about the role of law in the physical world as well.

I. THE RISE OF THE MACHINES

A. The technological background

How did 2016 come to be the year of VR and AR? From a technical perspective, the success of AR and the ability to start deploying VR stem from several trends coming together.

First, computer processing power continues to grow exponentially, roughly following Moore’s Law. That permits real-time processing of enormous amounts of data on ever-smaller devices. It also permits highly realistic graphics, as anyone who has played a modern computer game can attest.

Critical to VR, what was impossible with even a cluster of supercomputers a decade ago—real-time rendering of a world that surrounds you and responds as you interact with it—can now be done on a home PC and deployed to a lightweight, fairly comfortable headset. Indeed, lower-quality VR images without interactivity but with full surround

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8 See https://en.wikipedia.org/wiki/Moore’s_law.
video are already being sent to your smartphone with a headset made of cardboard.\textsuperscript{9} For the moment, the best VR experiences require a cable connected to your PC, but that’s likely to change soon, as on-board headset processing power and wireless communications technology improve.\textsuperscript{10}

AR takes advantage of the same technological developments, but also some additional ones. First, likely about two billion people in the world now have in their pockets a computing device of incredible power.\textsuperscript{11} Second, wireless connectivity lets that device connect to the Internet and other devices in almost all populated places in the world. Third, those devices come with very good built-in location tracking services. Those factors put together mean that you can send graphics and other information to a phone or other portable electronic device and know where that phone is and where it’s looking when you do.

AR and VR also differ in the openness of the technologies they employ. If you play Pokemon GO, the monsters you see on your screen are provided by the game maker, Niantic. But the screen on which they appear is your smartphone. The game can be played on any phone platform, and players with iPhones can see and interact with players with Android phones. AR is, at least generally, interoperable.

VR, by contrast, is not. VR is currently the province of a variety of proprietary headsets, such as the Oculus Rift, the Vive, the Playstation VR, and the HoloLens. Each platform runs its own games, sometimes on different computer hardware. While we expect that more games and apps will be written to work on multiple platforms over time, for the foreseeable future those programs will not work across platform. If I want to interact with a friend in a VR game or business meeting, we both have to wear the same type of headset.

\textbf{B. The practical applications}

So far, most uses of VR and AR have been in gaming. Pokemon GO is a good example of AR using phones plus location plus graphics processing to generate images that are superimposed on the real world, allowing players to go to real places to find and capture virtual monsters. VR gaming offers far more exciting prospects, because it takes the user

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into the game itself. Rather than controlling an avatar on a screen, the user becomes the avatar, and the physical movements of her body translate into the world she perceives around her. Even at this early stage, the effects of the technology can be remarkable.

Some readers may be inclined to dismiss VR and AR as unimportant because they are “just” gaming platforms. That would be a mistake. First, gaming itself is an enormous and underappreciated business and social phenomenon. Gaming is a significant phenomenon worth studying in its own right, and likely to become more so over time, since it is growing far faster than other forms of media. About 25 million Americans identify themselves as active video gamers. The industry is a $30 billion annual business in the U.S., and $90 billion worldwide. It has spawned its own popular television network, Twitch TV, and in 2015 more people tuned in to watch the finals of a League of Legends tournament than watched the NBA basketball finals.

And VR also changes the way people react to games. Kids playing violent VR videogames, for example, have higher physiological arousal and aggressive thoughts than those observing someone play the game on a 2D screen.

But the use and promise of AR and VR are also not limited to gaming. Google’s entry-level phone-based VR app, Cardboard, launched with immersive video news reporting, allowing you to visit Syria and other news hot spots around the world, looking around (though not interacting). VR programs like Tiltbrush are already letting artists create art in three dimensions by working inside their creations. VR art has al-

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15 Sandra Calvert & Siu-Lan Tan, Impact of Virtual Reality on Young Adults’ Physiological Arousal and Aggressive Thoughts: Interaction Versus Observation, 15 J. APPLIED DEVELOPMENTAL PSYCH. 125 (1994).


ready appeared in major museums.\textsuperscript{18} VR systems will allow a new generation of computer-aided design of products.\textsuperscript{19}

Other VR projects have included diversity training that lets people change their race or sex and see how others interact with them when they look different than they do outside VR.\textsuperscript{20} VR will also doubtless be used for training people for various physical tasks; think airplane simulators, but for activities that have much more complicated and dynamic controls.\textsuperscript{21}

AR is technically quite interesting, and will become even more so when it moves from cell phones to glasses. The first well-known attempt, Google Glass, proved to be a failure.\textsuperscript{22} But we think that is a problem with this particular implementation. The technology, when implemented right, will be powerful and profoundly appealing, not just in gaming but at work and in social life. AR apps include not only gaming, but the ability to superimpose relevant data over an image on a computer screen. Google Glass offered a computer screen that projected information over a real view of the world.\textsuperscript{23} Other AR projects include heads-up displays for pilots and drivers that let them access important information without looking away from the road or the runway.\textsuperscript{24}

AR glasses can help workers in their jobs, by pointing out extra information about the objects they are manipulating, or alerting them to safety risks. They can help people professionally by giving them instant access to information they may need for their negotiations or other business conversations. Most relevant to what we’ll be discussing below, they can help people interact with coworkers, business partners, friends, and family who are not physically present, by projecting the other person’s image into the wearer’s field of view. Coupled with high quality audio, such video presence can create much more lifelike interactions than currently available with Skype and similar videoconferencing systems. Implemented well enough, it can save billions of dollars in business travel costs (especially considering the cost of traveler time as

\begin{itemize}
  \item \textsuperscript{18} Id.
  \item \textsuperscript{20} Marco della Cava, \textit{Virtual Reality Tested by NFL as Tool to Confront Racism, Sexism}, USA TODAY, April 8, 2016.
  \item \textsuperscript{22} Nick Bilton, \textit{Why Google Glass Broke}, N.Y. TIMES, Feb. 4, 2015.
  \item \textsuperscript{23} Hayley Tsukayama, \textit{Everything You Need to Know About Google Glass}, WASH. POST, Feb. 27, 2014.
  \item \textsuperscript{24} Matt Richtel, \textit{Windshield Devices Bring Distracted Driving Debate to Eye Level}, N.Y. TIMES, May 29, 2015.
\end{itemize}
well as of transportation and hotels). And it can help people maintain friendships and family life across distance.

And there is much more coming. The ability to overlay data on an image of the real world (or, with Glass, on the real world itself) has myriad possible uses beyond depicting cute monsters. Imagine that you walk into a cocktail party and someone who looks vaguely familiar comes up to say hello to you. AR offers the possibility that your glasses could run facial recognition software, identify the person, and unobtrusively tell you who they are (and remind you of the names of their spouse and kids, and the last time you saw each other). 25

VR and AR also offer the possibility of real-time interaction with people from around the world—not just text chat, or even video conferencing, but actual interaction. Interacting in a virtual space lets people behave naturally in a way that a phone or computer screen will not permit. It also allows collaborative design of art, architecture, or virtually anything else.

And then, inevitably with new technologies, there is sex. Realistic, interactive pornography—whether with live remote participants or with software constructs—is likely to drive a significant amount of early VR business, and also to push technical development in VR towards more realistic avatars. That will be important for reasons we discuss in Part IV. And the development of sexual “haptics,” devices that can reproduce sensations and not just sights and sounds, will take things far beyond mere pornography.

C. The effect on our interaction with the world

1. Distraction

VR and AR will not simply offer new ways for us to interact with each other (or to interact with constructed worlds with or without each other). Based on what we know from existing VR and AR, both technologies will affect the way people interact with the world around them.

Consider the distracting tendency of AR. It is no surprise that people find cell phones distracting. Traffic deaths are up after years of decline, 26 in large part because people are texting and driving. 27 Phones

25 Natasha Singer, Never Forgetting a Face, N.Y. TIMES, May 17, 2014 (discussing Namtag, an early app for Google Glass which accomplished this). Oddly enough, the ancient Romans had a special job category for a human who performed such services for politicians who wanted to pretend to know voters’ names—a nomenclator. William Safire, On Language, N.Y. TIMES, Dec. 30, 1979.


are attractive nuisances, and we are generally less good than we think we are at splitting our attention between them and the real world.

But if a normal cell phone screen is distracting, AR has the potential to be especially so. While some AR implementations—such as heads-up displays—are designed to minimize distraction, the temptation to just look for a moment at the latest alert is almost irresistible. That temptation becomes even stronger when the alert doesn’t signal you from your hand or your pocket but actually overlays what you see with your full field of vision. There are already instances in which people playing Pokemon GO have walked off a cliff or into oncoming traffic. And the distractions of AR are only likely to increase with time.

2. Immersion

If we react to AR by splitting our attention (badly) between the world around us and the virtual world layered on top of it, we react to VR by ignoring the real world entirely in favor of the world we experience inside the headset. If you haven’t experienced true immersive VR for yourself, you might find it hard to believe just how real it feels inside the headset. But one experiment may give some perspective.

In one VR application, you can walk out onto what appears to be a board high in the air and jump off. You are not, of course, standing high above the ground. Your mind knows this, because a minute ago you were standing in a flat room, because there are people standing right next to you talking to you, and because you know you are in a VR experience.

Nonetheless, a large proportion of the people in this simulation won’t even walk out onto the board because it looks precarious. Some panic and have to take the headset off altogether. Of those who do walk out, most aren’t willing to step off the “plank” and (presumably) fall, even though the step is in reality only a single step on a flat surface in a normal room. And even those who do step off—who presumably let their intellectual awareness of their physical surroundings control what their senses are telling them—invariably lean forward and start to fall as they take that one step, because their body is signaling them that they are falling.

There are many more examples of the very real feeling we get when we are in VR. We experience what happens there as if it were really

30 Liat Clark, Walking the Plank with the Oculus Rift is Stomach-churning stuff, WIRED, May 30, 2013.
happening, whether it is a close encounter with a whale, or enemies jumping out to take shots at us.

One study used VR to replicate the Milgram shock experiment—a famous psychology experiment in which a subject is asked to press a button to electrically shock a stranger in another room. There are no actual shocks delivered with the button, but during the experiment, the stranger cries out in pain and the subject hears those cries.

In the original Milgram experiment the test subjects thought they were administering real electric shocks to real people. Not so in this experiment. In spite of the fact that all participants in the VR study knew that neither the stranger nor the shocks were real, the “participants tended to respond to the situation at the subjective, behavioural and physiological levels [as measured by skin conductance and heart rate] as if it were real.” Those subjects who interacted with the stranger via text screen did not produce comparable levels.

Many people cannot separate their intellectual understanding of what is happening from the very different signals their body is sending them. And even for those who can, the body will not be ignored. It releases chemicals in response to perceived threats, pleasures, or opportunities whether or not the brain knows those things aren’t real.

People in VR environments physiologically respond to actions done to them in VR. Subjects who see themselves getting slapped in VR respond with skin conductance and heart rate levels as if they were actually getting slapped. The results are replicable even when the subject is male and their VR “body” is female.

Indeed, the realism of VR can be harnessed for therapy. VR has been effectively used to treat stress and brain damage because the

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32 Mel Slater et al., A virtual reprise of the Stanley Milgram obedience experiments, 1 PLOS ONE e39 (2006); Marcus Cheetham et al., Virtual Milgram: empathic concern or personal distress? Evidence from functional MRI and dispositional measures, 3 FRONTIERS HUMAN NEUROSCIENCE 29 (2009).
33 Slater, supra note 32.
34 Mel Slater et al., First person experience of body transfer in virtual reality, 5 PLOS ONE e10564 (2010).
35 Id.
36 Matilda Annerstedt et al., Inducing physiological stress recovery with sounds of nature in a virtual reality forest—Results from a pilot study, 118 Physiology & Behavior 240 (2013); Youssef Shiban et al., Trier Social Stress Test in vivo and in virtual reality: Dissociation of response domains, 110 INT’L J. PSYCHOPHYSIOLOGY 47 (2016).
human nervous system responds to stimuli in VR environments similarly to ones in the physical environment. Several studies have particularly focused on the treatment of anxiety disorders through exposure therapy in VR; though overall anxiety was lower in VR environments, the magnitude of anxiety decline in the VR treatment and real-world treatment was similar.38

VR therapy has also been compared to imaginal therapy—asking patients to imagine the anxiety-inducing situations. Patients in VR therapy exhibited more anxiety during therapy but a greater decline in anxiety as a result of therapy than did patients in imaginal therapy.39 VR made the experience seem more real.

VR is, in a word, a visceral experience. Things that happen there aren’t physically real: If the bad guy shoots you in Bullet Train, you don’t die in real life. But they feel very real indeed.

And those feelings can in turn have real physical consequences. You could literally be scared to death (or at least into a heart attack) by a game that felt sufficiently real. Even if you aren’t physically harmed, you will have experienced what you saw and did in VR in a way that you do not on the Internet or in a normal video game. And that fact has significant consequences for how the law intersects with VR, as we will see in the next Part.

3. Image

VR and AR, when they show us to others, don’t show us as we actually appear. Capturing our actual appearance in 3D, transmitting this video, and superimposing it on the receiver’s VR environment is too difficult even for modern technology. (It requires not just extra bandwidth, but many cameras surrounding us.) Instead, we appear through our avatars. Today, the avatars look cartoonish, but they will become increas-


ing realistic-looking, and will include our facial expressions, which will be captured in real time and superimposed on the avatar.40

But realistic-looking need not mean real. They could, for instance, be nicely dressed and coiffed versions of us, even if when we’re actually hooking into VR in our pajamas before our morning shower. Naturally, they could be somewhat younger and better-looking versions of us. Or if we’re young but want to seem more mature in business interactions, we can use slightly older-looking avatars. In any event, we will look like we want ourselves to look, no longer bound by the limitations of our actual appearance (except insofar as social or business conventions might treat sharp departures from our real appearance as untrustworthy or manipulative).

Indeed, avatars could be largely or entirely disconnected from our real appearance: of a different sex, of a different race, with different facial features, lacking our disabilities. Or they could look like dinosaurs. This could be done for experimentation, for pseudonymity, or to avoid hostility.

This malleability of visual identity has minuses as well as pluses. Easy pseudonymity could mean less social accountability (just as physical distance may mean less legal accountability—more on that later). People could also feel professionally or socially pressured to take on personas that seem inauthentic to them, but that seem more profitable. This may be true with regard to race and sex, but it will be even more true of avoiding physical features that our society views as ugly or off-putting.

At the same time, many people are likely to be quite enthusiastic about the possibility of beauty—or just being aesthetically average—coming at next to no cost and next to no investment of time. Many women spend hours each week on makeup and hair for work; that may be a regrettable demand of our culture, but it’s quite real. If they can instead VR- and AR-commute, all that time will be saved. More importantly, many people who are self-conscious about their appearance can be freed from that. Many who find themselves treated worse because they are obese or otherwise socially stigmatized will be able to avoid that.

And of course, as with much modern technology, VR and AR will be especially useful for people who are physically disabled—not just because they could conceal their disabilities, if they want that sort of privacy, but because they could often much more easily “get around” in VR and AR than they could in the physical world. It’s not clear to us how much all this will affect law as such, but it will certainly affect people’s experience of the technology. (Returning to a point mentioned in the

previous section, it will especially affect people’s online sex lives; but appearance unfortunately matters in business and socializing as well.)

Indeed, the ability to obscure aspects of one’s identity has proven socially useful in other contexts. The percentage of women who won jobs in orchestras went up dramatically after orchestras began blind auditions in which the interviewers didn’t know the race or gender of the person performing.41

VR offers the same possibility for job interviews. We may be able to significantly reduce subconscious race and gender bias in interviewing (as well as bias against fat, bald, or ugly people) if the interviewers see an avatar who doesn’t look like the real person. On the other hand, to the extent that the VR software lets one modify the facial expressions that one is sending, that could hide potentially valuable visual cues related to how much attention the interviewee is paying, how much attention he is showing, and the like.

4. Data

The reality you feel in VR is made out of bits, of data. And because it is, it is owned and stored somewhere by a private company—or perhaps several. Those private companies will invariably impose terms of use that purport to bind users of the hardware and software. Those terms may disclaim liability for harm. They may assert ownership over the things we create in VR. And they may require us to consent to having information about our conduct in the virtual world recorded and shared.

Our movements and actions in the physical world are increasingly observed, recorded, and tracked. But there are still spaces where we are not followed and acts that are not recorded and searchable. In VR that will likely not be true. Everything we do, we do before an audience—a private company that may well keep and catalog that data, and may have lots of reasons to do so (data mining, security, user convenience, and more).

Of course, the same is true of the Internet today. But we may do, say, and experience things in VR we would not put in an email. That VR feels like the real world may cause us to treat it like the real world. When we feel like we are alone with someone, we may be more likely to share intimate secrets than we would on a public street, or even in an email. But in VR those secrets are, inevitably, being recorded somewhere, and are likely being retained.

41 Christina Duff, Female Musicians Fare Better When Heard But Not Seen, WALL ST. J., Mar 7., 1997.
II. CRIME ON THE VIRTUAL STREET

That, then, is the likely technical and social reality of VR and AR. What legal problems will it cause? Let us begin with the VR and AR equivalents of street crimes.

A. What would VR/AR street crimes be like?

Much traditional criminal law enforcement involves street crimes: in-person misconduct, such as robbery, sexual assault, indecent exposure, or disorderly conduct. Many such crimes literally happen on the street. Many others happen in homes, businesses, or schools, but share many traits with traditional street crimes.

Many of the worst such crimes aren’t a problem in VR. You generally needn’t worry about being really murdered in a virtual space. Likewise, you needn’t worry (subject to some complexities that we’ll mention below) about being really beaten or raped.

Indeed, this could be one reason people will shift some activities to VR. Physically going out to drink with friends might be more fun in some ways than getting a virtual drink, where everyone is physically at home but can see each other in VR. You can hug your friends in a real bar. You can feel physically close to them and not just emotionally close. If you’re looking to pick up a sex partner for the evening, doing that in VR would require haptic hardware that goes beyond what we have today.

Yet going out together for a virtual drink—to be precise, staying in for a drink, but being virtually together—has its own advantages. You needn’t worry about getting into a bar fight, or getting mugged on the way home. You needn’t worry about driving home drunk, or paying for a cab. Plus, the booze is much cheaper at home.

Still, as we’ll discuss below, there may well be some kinds of “street crime” in VR. How will the law likely deal with that? How should it?

1. Disturbing the peace and the Bangladesh Problem

What sorts of street crime can there even be in VR? Today’s VR is basically audiovisual—you can see and be seen and hear and be heard, but you can’t be punched or shot or caressed. (Caressed is surely on its way, but not here yet.) We thus focus on crimes of sound or of sight.

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42 Of course, people are working on changing this. See, e.g., Alex Hawgood, ‘Interactive’ Gets a New Meaning, N.Y. TIMES, Dec. 24, 2013.

43 A drinkable $15 750-ml bottle of hard liquor contains about 15 shots’ worth (assuming each shot is 50 ml, or about 1.75 fl oz), so that amounts to $1 per shot. Your VR headset can pay for itself so quickly.

44 See supra note 42.
A classic sound crime is disturbing the peace through loud noise, for instance through screamingly loudly in a public place. That crime can pose First Amendment problems when applied to speech that disturbs because of its content, but it’s pretty straightforward when applied to speech that disturbs because it’s too loud.

Indeed, if you see someone standing on the sidewalk screaming, calling the police is a standard response. You expect the police to come out, maybe talk the guy into going away, maybe arrest him, maybe even have him prosecuted. Dealing with such annoying street behavior is part of what police normally do.

Now say someone is screaming in a VR public place. Let’s assume this isn’t in a game, but in a place where people need to congregate for economic reasons—to shop at a VR store, or even go to their VR jobs. The harm caused by the screaming is the same: It interferes with people’s other tasks.

So you call the police.

“Officer, there’s this guy screaming and bothering my kids and me.”

“What’s the street address?”

“It’s not on the street, it’s in this VR world.”

[Pause.]

“We’re playing a virtual game in the virtual park, and this guy is bothering us.”

“Where are you, really?”

“Well, I’m sitting in my bedroom, but that’s not what’s important! I’m wearing my virtual headset, and it feels to me like I’m playing with my kids in the park—they’re with my ex across the country, but we’re spending some time playing together, and this jackass is ruining it for us.”

“And where is he, really?”

“Oh, I clicked on his avatar, and it tells me that he’s hooked up from Dhaka—you know, in Bangladesh. But it feels like he’s right next to us.”

[Click.]

Now maybe if you call a more technically savvy police agency, they’ll understand your concerns more quickly. But their reaction is likely to continue to be skeptical, because of what we label the “Bangladesh problem”: It will take a lot to get domestic police interested in investigating

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45 See, e.g., CAL. PEN. CODE § 415 (2015)
a crime where the criminal is in a foreign country. Indeed, it will take a lot even if the criminal is in another American state, or perhaps even in another city. Getting some extradited is a hassle. Even dealing with another jurisdiction’s police department to arrange an arrest in the same state is a hassle.

Will they go through the hassle to investigate a murder? Maybe. But, “You think I can get someone extradited from Bangladesh for disturbing the peace?,” the police officer might ask you. “Or even from Nebraska?” Indeed, perhaps your state won’t even have jurisdiction over such crimes committed by people screaming in their rooms elsewhere in the world; but even if the state is legally entitled to prosecute such crimes, it would surely be very hard for local police and prosecutors to bring such a prosecution.

And there’s every reason to think that the VR street criminals would indeed live all over the world. There are no oceans or borders in VR—that is one of its advantages. The VR “places” in which Americans will travel will be disproportionately Anglophone (though good real-time translation might change that), and disproportionately drawn from richer countries. Yet many of the people who share the same VR “street” will be oceans apart, and most will at least be from different states.

The same problem already exists to a significant extent on the Internet. The people who harass you or even threaten you on Twitter or Reddit, can as easily be in South Africa as in South Carolina. Courts handling civil cases have struggled for decades with how to address the problem of people who cause injury far from where they live. But criminal prosecutions for such transnational threats appear to be vanishingly rare.

Yet the illusion of presence that VR and AR bring is likely to make potentially criminal incidents more common. It’s relatively rare for someone in a foreign country to care so much about us that he would tweet death threats about us; it happens, but only for pretty high-profile people. Most threats seem likely to stem from personal, emotionally laden interactions that usually require a sense of in-person connection—people threatening their exes, gang members, schools, and the like.

But the crimes we describe in this subsection and the coming ones are likely to be much more common. People scream and create a public

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48 We have nothing against Bangladesh: It's just a good example of a populous country that is very far away, that contains millions of English speakers, that likely won't make it trivially easy to extradite petty offenders, and that has a fun polysyllabic name. Use “South Africa problem” or “India problem,” if you prefer.

49 Alec Ross, The Language Barrier Is About to Fall, WALL ST. J., Jan. 29, 2016.

commotion in the real world; there’s no reason why they wouldn’t do the same in a VR space. People indecently expose themselves in the real world; there’s no reason why they wouldn’t do the same in VR (more on that below). Indeed, they may be more likely to do this, precisely because they may reasonably infer that it will be hard for the police to catch them. Moreover, there will be more desire for criminal prosecution than with Internet misconduct, precisely because the feeling of physical presence may make the victims of VR street crime viscerally feel victimized. That desire, though, may be hard to satisfy.

To be sure, VR does tend to facilitate policing in one way, by solving some problems of proof and identification. If the VR platform keeps good logs, it can accurately report just which avatar was screaming, and just how loud he was. And perhaps the VR platform requires people to identify themselves before accessing it, at least with a credit card; or with the proper subpoenas, the typical avatar can be traced back to an Internet subscriber. But the greater difficulties caused by extradition are likely to exceed the greater ease of proof. And many VR street crimes might thus be practically ignored by traditional police department.

Of course, this might yield pressure for VR operators to set up in-VR “police,” who might be able to deal with transgressors quickly; and there might be “courts” as well, for resolving disputes (especially disputes involving in-VR commerce). But the penalties will likely be, at most, suspension or ejection from the VR environment. And it seems likely that the ejected participants can just get back on by creating a new user ID.

If a VR environment requires people to provide a credit card, or otherwise supply a deposit, such new user IDs might become harder to create, and the environment might even threaten fines or forfeited deposits for bad behavior. How often this will happen will depend on economic factors that we can’t easily predict. We expect that many VR environments will want to allow free access, or at least access that doesn’t require a credit card (but might require only some prepaid gift card), since the VR operators will want to harness network effects by increasing their user bases. Presumably, those operators will make money from in-VR purchases rather than through credit card subscriptions. But we’re not certain whether this will be so; indeed, some environments might want to require credit cards or elaborate identification systems precisely to maintain a more orderly experience for their users.

So the real-world police are unlikely to intervene to stop the VR street screamer. But there’s a good reason why disturbing the peace is a crime: It affects people’s quality of life, and tends to push them away from a place where they want to be, and where we might want them to be (for instance, if we want them to work there or shop there). And the creators of the VR environment will be keenly aware of this, because lost quality of VR life means lost profits to them, especially since different VR environments will likely be hotly competing with each other.
Code, as Larry Lessig put it, is law—maybe the most effective sort of law. And VR environment operators can easily implement code that can deal with the screamers. The operator could, for instance, allow each user to control the perceived volume, for that user, of any other user. That’s good not just to silence the screamers, but also to quiet down acquaintances who are a bit too loud, or to amplify acquaintances who mutter. And this should be technically trivial to code.

The instruments of the real world—real ears and real brains—don’t have such a feature. But the sensescape created by the VR software is more versatile and more individually controllable than what mere human anatomy can provide. Taking advantage of this versatility can help prevent or quickly interrupt VR street crime. Yet shifting to these in-VR remedies likely means shifting away from the criminal law, and from the standard criminal law penalties.

2. Indecent exposure

We can see the same if we consider another crime, this one visual rather than aural: indecent exposure.

There you are, minding your own VR or AR business, and you see this avatar a few feet away from you—and he’s naked. Plus he’s unusually well-equipped; if you’re going to have an avatar, why settle for mere realism? Or maybe he’s naked and deliberately grotesque. (Two penises?) Or maybe he’s masturbating. Or having sex with someone.

You avert your eyes, but he pops right in front of you, wherever you look. And this might happen even when you aren’t practically able to leave—for instance, if your in-VR job requires you to be “present” in that particular VR “location.”

If this were happening on a street, the exhibitionist would probably be arrested for indecent exposure or public lewdness. But whether this law can be applied in VR turns out to be surprisingly complicated.

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52 AltSpaceVR, a prominent program for social interaction in VR, already has such a feature. AltSpaceVR, *How Do I File an Abuse Report?*, Mar. 1, 2017, https://help.altvr.com/hc/en-us/articles/206865083-How-do-I-file-an-Abuse-Report- (“Before you submit [an abuse] report, we suggest Muting the individual that is being a disturbance. You can click the ‘Mute’ button on their nametag. This will cause them to stop moving and will eliminate any audio that they may be producing through their microphone.”).

53 By “sensescape,” we simply mean the array of sensory inputs that a VR environment provides to users: today, mostly sights and sounds, but it could soon include touch, smell, temperature, pain, and more. Riley Snyder, *Getting Physical with Virtual Reality*, L.A. Times, Jul. 18, 2014.

54 He might also be deterred by social convention, or perhaps by the sense that he doesn’t look that good naked. But in VR, he can look as good (or as grotesque) as he wants, and he doesn’t have to show his real face. There may be
The Supreme Court has held that public nudity may be banned even in strip clubs, where the patrons pay money to see such nudity.\textsuperscript{55} But the Court has also held that the First Amendment protects public displays of films containing nudity, even on drive-in theater screens visible from the street, where unwilling drivers and pedestrians may see the nudity (moving, in color, twenty feet high).\textsuperscript{56}

Even outside VR, this can be confusing enough that a Michigan appellate court has upheld an indecent exposure conviction for a man’s displaying his penis on a public access cable television show that he produced.\textsuperscript{57} This seems inconsistent with the drive-in case,\textsuperscript{58} but it may just reflect a deeper inconsistency between the drive-in case and the public nudity cases.

This gets even more complex when we go beyond video of nudity to video of sexual behavior. If the video is obscene, then it can theoretically be punished even when the viewers are consenting.\textsuperscript{59} And even material that is not outright obscene enough but is nonetheless “obscene-as-to-minors” might still be punishable when it is deliberately shown in public places where minors may be present.\textsuperscript{60} But the Court has held that the government can’t ban such obscene-as-to-minors material online, even in places that minors can access, because a less restrictive alternative is to have parents use filtering software to shield their children, if they so wish.\textsuperscript{61}

Perhaps the drive-in case and the public nudity case, though, can be reconciled: Public nudity is viscerally perceived as real and immediate in a way that a video display is not, the theory would go; and public nudity thus evokes reactions from which the law can legitimately protect people.

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immediate and temporary social sanctions—for instance, if he goes naked into a VR shop, he might get ejected—but then he can just quickly change his avatar to something clothed, and then change it back when he’s done shopping.

\textsuperscript{56} Erznoznik v. City of Jacksonville, 422 U.S. 205 (1975).
\textsuperscript{58} One of us filed an amicus brief in Huffman supporting review by the Michigan Supreme Court, but that court denied an appeal, by a 5-2 vote. People v. Huffman, 708 N.W.2d 95 (Mich. 2006).
\textsuperscript{59} Miller v. California, 413 U.S. 15 (1973).
\textsuperscript{60} See Crawford v. Lungren, 96 F.3d 380 (9th Cir 1996) (upholding ban on unattended coin-operated newstand sales of “harmful to minors” material); American Booksellers v Webb, 919 F.2d 1493 (11th Cir. 1990) (upholding ban on display, in a place accessible to minors, of any material that’s “harmful to minors”); Davis-Kidd Booksellers, Inc. v McWherter, 866 S.W.2d 520 (Tenn. 1993) (same).
\textsuperscript{61} ACLU v. Ashcroft (II), 542 U.S. 656 (2004).
If that’s so, public nudity in VR and AR becomes a harder case. After all, nudity in VR is technically display of video (as in the drive-in case) but also functionally aimed at emulating in-person presence (as in the public nudity cases). And while the avatars so far are relatively cartoonish, it won’t be long before a nude VR avatar—normal size, with normal movements, seemingly standing next to you—feels a lot more like a physically present person than it does like a picture on a screen.

One reason the law forbids indecent exposure is that such public nudity may lead some observers to worry that the exposer may move on to sexual assault. That is a serious worry when the exposer is physically nearby, but not when the exposer is present only virtually. Nonetheless, unwanted exposure to others’ nudity may cause feelings of unease even when it is logically clear that no in-person assaults are possible. So whether we should be more worried about indecent exposure in VR may depend on whether we think the primary focus of the law is on the unease that it creates among passersby, or on public indecency as a proxy for future physical attack.

But maybe this legal conundrum is likely to stay academic. First, we’re back to the Bangladesh Problem. How many police departments would relish the prospect of trying to extradite someone from a foreign country, or even another state, because his online avatar is nude?

Second, as with loud avatars, VR users may be able to protect themselves from unwanted nudity in many circumstances. VR environments can easily be designed to let users change how others’ avatars appear to them. “My avatar,” after all, is just a visual image that I would like to present in displays that come up on others’ VR goggles, communicated through the VR software on central computers and on other users’ computers. Those users don’t have to perceive me as the avatar I chose.

They could, for instance, substitute another avatar; if my avatar is Adolf Hitler and they don’t like it, they could substitute Mahatma Gandhi (or vice versa). Or they could just edit the avatar: If my avatar is naked and they don’t like it, they could color it solid green, or perhaps solid green except the face (software permitting, but this should be easy software to develop). Conversely, if they’d like to see more nudity, they could replace my avatar with whatever naked version—again, whether attractive or grotesque—they prefer.

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63 Allowing that sort of modification may create other legal problems, however, as we discuss below.

64 The VR operator might also let the VR store outside which the nude avatar—or the screamer—is standing exercise some control over such behavior.
Indeed, they could probably use a program that automatically blacks out all the naked parts of naked-seeming avatars.\(^{65}\) Or the operator can require people who select a nude avatar to also provide a nonnude version, so that people who prefer to avoid seeing nudity can select that with just one global switch. This might be useful if the automated editing yields results that are too crude to yield an enjoyable VR experience, or if the operator wants to minimize even the initial unwilling exposures to nudity.\(^{66}\)

Now let’s play out again a conversation with the police, focusing on how this technologically enabled self-help might affect their decision.

“There’s this avatar standing in the VR park, and he’s completely naked!”

“Why don’t you just hit the ‘dress up the avatar’ button?,” the police officer asks. (Again, we assume an officer who knows something about VR.)

“I shouldn’t have to do that!,” you say. “He’s violating the law, and it isn’t up to me, the victim, to try to avoid that.”

And that’s a plausible argument, in theory; as you point out to the officer, “After all, ‘To say that one may avoid further offense by turning off the radio when he hears indecent language is like saying that the remedy for an assault is to run away after the first blow. One may hang up on an indecent phone call, but that option does not give the caller a constitutional immunity or avoid a harm that has already taken place.’ Justice Stevens said that, you know. In *FCC v. Pacifica*.\(^{67}\) Same for nudity as for vulgar language.”

But our police officer is not a theorist. “Are you telling me that you could have avoided this problem by clicking on a button,” he says, “and you’re bothering me? I have real crimes to deal with—ones in which the victims really need me to do something that they can’t do for themselves.”


\(^{66}\) Presumably the operator would enforce this by threatening to delete nude avatars that lack a nonnude version and that yield complaints, and perhaps to delete the offending users’ accounts and make it a hassle for them to create new ones. This won’t stop the determined repeat offender, but given that it’s easy enough to create both a nude and nonnude avatar, most users would likely choose to comply with the operator’s policy rather than go to the trouble of repeatedly evading it.

\(^{67}\) 438 U.S. 726 (1978).
Or, if the officer is a theorist, perhaps he is one of the economic rather than deontological variety. “You are the cheapest cost avoider here,” he says. “You can avoid the unwanted nudity with just a few clicks, whereas I would have to go through much more effort to prosecute it. I know that the criminal law does not usually formally focus on that; but, practically, it makes me reluctant to give your call a high priority.”

Now of course there are limits to this “you should have avoided the problem yourself” argument. Presumably if the crime is more serious—say, burglary—the police wouldn’t just say “your own fault for having left your front door unlocked, we won’t investigate the case.” But for minor enough crimes, and ones where the main worry is prevention going forward, the police are unlikely to invest many resources into such prevention when citizens can more effectively prevent the problem themselves.

And this tendency only increases as a result of the Bangladesh Problem. As arrest and prosecution becomes much more expensive for the police, and technologically enabled self-protection simultaneously becomes less expensive for citizens, the police are likely to become less interested in intervening, especially in cases that don’t seem to them to involve any “real” harm.

3. Strobe lighting

Here’s a possible test case that does involve a serious harm that is harder to avoid: About 3% of people who have epilepsy—disproportionately, young people—can have seizures triggered by strobe lighting.68 Though such seizures tend not to be fatal, or even greatly injurious, at least when the person having the seizure is just sitting in his home in front of his computer, they do involve a nontrivial risk of injury. This hasn’t been seen as reason enough to generally ban strobe lights, especially since such lights seem to be entertaining for many people, and are sometimes used as a safety feature.69 But deliberately creating a strobe effect in VR precisely to play a nasty prank on someone you know to be endangered by this would likely be tortious or even criminal.70

68 About 1% of the population has epilepsy, Rosemarie Kobau et al., Epilepsy in adults and access to care—United States 2012, Morbidity and Mortality Wkly. Rep. 909, 910, so this 3% of 1% amounts to about 100,000 people in the U.S., and many more outside.


But here, too, a program running on a user’s VR headset might be able to detect strobe lighting and convert it to something nonstrobing. People who know they are strobe-sensitive, or who even think they might be, could then easily turn on this program.71

The initial exposure—for those who have neglected to get and turn on such a program, or for those who are unaware that they need it—is materially more dangerous than in the disturbing the peace scenario: physical injury, and not just annoyance. And an attempt to deliberately trigger a seizure, as in our hypothetical, is highly morally culpable. The purpose is to harm someone, even if most of the time the purpose will be frustrated by the targets’ precautions.

Would this be enough to lead the police to be willing to intervene? Or would they likely not think this to be worth triggering a possible interstate or international investigation, when, at least going forward, the victim could avoid such harms through technological means?

The strobe light example is the rare virtual hypothetical that combines such culpability with the real risk of physical injury, but others might arise in the future: Imagine, for instance, a hack that alters the VR camera positioning information so that a user who thinks she is in the middle of her living room is in fact standing at the edge of the stairs, or that deliberately sends someone using AR walking into a wall or off a cliff. The use of VR (or, more likely, AR) systems to deliberately cause physical harm to a user is more likely to get the attention of police and courts than are disturbing the virtual peace or virtual indecent exposure. But it will do so precisely because the consequences are more obviously physical rather than virtual.

4. “Virtual groping”

Harm, though, can also feel real without being physical. Only a few months after commercial VR became available, a woman named Jordan Belamire (a pseudonym) was “virtually groped.” Belamire recounted playing a multi-player zombie shooter game when another player—who recognized Belamire as female by her voice—began to make gestures that seemed like virtual groping:

In between a wave of zombies and demons to shoot down, I was hanging out next to BigBro442 [the other player], waiting for our next attack. Suddenly, BigBro442’s disembodied helmet faced me dead-on.

71 For a pre-VR analysis of this, see How Is TV Made Safe for People with Epilepsy?, BBC, June 7, 2007; see also Univ. of Md. College of Info. Studies, Trace es. & Dev. Ctr., Photosensitive Epilepsy Analysis Tool, https://trace.umd.edu/peat (offering a free program that will analyze whether a video poses an epilepsy seizure risk, and that could likely be easily adapted to provide real-time filtering of dangerous strobing).
His floating hand approached my body, and he started to virtually rub my chest.

Even when I turned away from him, he chased me around, making grabbing and pinching motions near my chest. Emboldened, he even shoved his hand toward my virtual crotch and began rubbing.

And Belamire reports that BigBro442’s behavior, though utterly lacking in physical contact, seemed so realistic as to be disturbing. Belamire had earlier in her article described how realistic a VR cliff seemed to be, triggering her fear of heights.

“The virtual groping,” she said, “feels just as real. Of course, you’re not physically being touched, just like you’re not actually one hundred feet off the ground, but it’s still scary as hell.” Her experience is consistent with the studies we reported in Part I.C.2 suggesting that people react physiologically to touches in VR much as if they had happened in the physical world.

Under current law, virtual groping probably wouldn’t be a crime. It isn’t sexual battery, because there’s no touching. Tort law tends to define “assault” as including an actor’s intentionally putting someone in “imminent apprehension” of “offensive contact,” but criminal law tends not to outlaw such behavior unless it is actually an attempt to commit battery. And beyond that, it’s not clear that such imminent apprehension would be present when the target consciously knows that no physical contact is possible. While sexual threats by remote actors over the Internet have sometimes been treated as crimes, those cases all hinge on the plausibility that the threat made over the Internet will be carried out in the physical world.

Should the law be changed? We suspect that very few people would find virtual groping, accomplished through purely visual means, to be as upsetting as real groping. Nonetheless, Belamire is doubtless right that, because of the visceral feeling created by virtual reality, such virtual...
groping will be more upsetting to many people than getting an unwant-
ed tweet or an email expressing sexual desire.

And peoples’ reactions may well depend on how developed and per-
sonalized their avatar is, something that differs from platform to plat-
form and game to game, and that is likely to change over time. Perhaps
virtual groping will be upsetting enough to treat it as the sort of action
that criminal law ought to, in principle, forbid, if not now than in the
near future. This question likely can’t be resolved until we have more
experience with how people actually feel in such situations.

Nonetheless, here too, as in the indecent exposure scenario, there is
reason to be skeptical of whether criminal law can and should apply.
First, as always, is the Bangladesh Problem: Few police departments
will be eager to extradite someone from another country or even another
state simply because he made gestures, however disquieting, in a virtu-
al reality game. Even police officers who greatly respect women’s bodi-
ly integrity may be hesitant to use a great deal of resources to deal with
people who, after all, did not literally touch anyone.

Second, here too technologically enabled self-protection may be
available. The physical structure of the real world is notoriously toler-
ant of people coming very close to you. Protection from unwanted touch
has to rely on legal rules, social mores, and the threat of violent self-
protection.

But the code-as-law of the VR world can easily forbid avatars from
approaching within some perceived distance of you, or forbid particular
people from doing it, or forbid this except in certain games. Indeed, VR
developers have already offered this as a response to Belamire’s article;
as the author of the VR game that Belamire had been playing wrote,

We should have prevented this in the first place. While QuiVr is
still in pre-release alpha, we’d already programmed a setting into the
game called your, “Personal Bubble,” so other player’s hands disappear
if they come close to your face. This way, the rare bad-apple player can’t
block someone else’s view and be annoying. The arrows that get shot at
you stick in your helmet, which is good for a laugh, but they do no dam-
age and quickly disappear so they don’t get in the way. We hadn’t,
thought of extending that fading function to the rest of the
body ....

I called Jonathan, who is . . . the original creator of QuiVr . . . .
He’d already seen the article—his girlfriend had sent him the link—
and he had spent the morning changing the game to extend the Per-
sonal Bubble; now, when the setting was turned on, other players faded
out when they reached for you, no matter their target, chest included. . . . It was a possible solution; no one should be able to treat another
player like the author had been treated again.78

78 Dealing With Harassment in VR, UPLOADVR, Oct. 25, 2016,
Indeed, the author suggested other technologically enabled self-protection options, including ones that come across as more active self-defense (or, if you prefer, retaliation)—perhaps, for instance, allowing a player to “reach[] out with a finger, and with a little flick, sent [the other] player flying off the screen like an ant.” One can even design the game so that this feature can only be used against those avatars who come too close to one’s own (or else the flicking could itself become a form of unprovoked aggression). Or the VR or AR company can set up a bubble feature that excludes some avatars but not others that the participant has placed on a “close approach permitted” list.

If people behaved better, none of this would be needed. But given that people do behave badly, VR and AR technologies sometimes offer better tools for dealing with bad behavior than the physical world does.

5. Crimes that can’t be easily technologically avoided—extortion, threats, and the like

This cheapest-cost-avoider/you-could-have-avoided-it-yourself argument, of course, only works for crimes that are indeed avoidable with technical measures. Many will not be. For instance, there is no technical feature that you can use to avoid someone trying to extort money from you in VR or AR by threatening you with attack in the real world (“I know where you live in the real world, and I’ll burn down your house if you don’t pay me $10,000 worth of VR goods”). There, you will have to rely on normal law enforcement and normal criminal law, subject to the constraints imposed by the Bangladesh problem.

But it’s no accident that extortion is not usually seen as a street crime, in the sense of a crime that is generally committed through physical presence (as opposed to through potentially long-distance communication, even absent VR). For a considerable amount of the street crime that has a VR analog, technologically enabled self-protection is a possible protection—and failure to use such self-protection may lead to the police having little sympathy for your plight.

6. AR crimes that can’t be easily technologically avoided—startling

Finally, let’s note one crime that is especially likely to be dangerous in AR: deliberately or recklessly startling someone in a way that’s likely to dangerously interfere with his physical-world tasks.

Say I know that you’re driving with your AR set engaged, and I deliberately appear in your field of vision—not just as me, but as a giant, loud, fire-breathing dragon (or perhaps as a very attractive naked person of whatever sex you find attractive). Or perhaps I happen to know that you have a fear of spiders, so that’s the avatar I choose, in an attempt to startle you. You are indeed startled and get into an accident.

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79 Id.
(In principle, this might happen even in VR, but the risks are greater when people are using AR, which they might do even when driving or walking down a busy street.)

That might well be a crime, such as reckless endangerment,80 or negligent homicide or involuntary manslaughter if someone dies.81 It could certainly be a tort (more on that in Part III). This would be one of the few scenarios—strobe lighting being the other—which could actually cause physical injury. And it is also not easily avoided through technological self-help measures.

But as a practical matter, this is likely to be a special case of the broader problem: AR can be distracting, especially for drivers82 but also for people walking near traffic and other hazards. AR designers will have to find some way of dealing with such normal incidental distractions; that might likewise be useful for dealing with deliberate but much more unusual distractions.

B. Diversity of Sensescape

Technological self-protection options, if properly designed, can do more than just make it unnecessary for police to intervene—such options can make possible a broader diversity of VR environments from which users can choose. Indeed, they can make it possible to have a broader diversity of experience within the same environment.

Consider the indecent exposure hypothetical. Some people may like being in an environment where some of the avatars they see are naked, or where they themselves come across as naked. They might be consciously seeking titillation. But they may also want realism, for instance if they are engaged in VR tourism to a place (or time) where women go topless.

Or they may want fantasy, if they want to visit a fictional world where nudity taboos are absent (or are different), or where mythical but part-human creatures (think satyrs or centaurs) are normally nude. Or they may be nudists, who feel more comfortable coming across as naked, and being around other people who do the same.

Leaving the policing of nudity taboos to each VR environment—or perhaps to each user in a VR environment—can increase people’s options. Some people will go to the nudist environments; others will go to nonnudist ones.

80 MODEL PENAL CODE § 211.1(2)(a).
81 MODEL PENAL CODE § 210.4.
82 Stephen Williams, As Head-Up Displays Become Common, Distraction Becomes an Issue, N.Y. TIMES, Sept. 10, 2015.
But beyond that, if the technologically enabled self-protection measures are available, different users will be able to have different experiences in the same VR environment. Those who like casual nudity can see nudists’ avatars as nude. Those who dislike it can see the same avatars as clothed. So even if you need to be in a particular VR environment (for instance, because your job so requires), you can experience that environment without the nudity.

To be sure, some people may have moral objections even to voluntary nudity; consider the public nudity laws that ban nudity even in strip clubs. But we think these objections should not be particularly strong. Even if bans on consensual public nudity are constitutionally permissible, we doubt that they are good policy; it’s better, we think, to live and let live on such matters, leaving people free to choose from a diverse range of environments. That is even more true when the environment itself is one you can choose whether or not to participate in.

The de facto toleration of nearly all online pornography throughout the U.S., even of pornography that is likely theoretically punishable as obscenity, supports our view. At least on the Internet, the Sexual Revolution is over, and sex won: Where the sex is entirely online, without bricks-and-mortar stores that are seen as potentially attracting bad elements, it is generally tolerated. And if the toleration stems from difficulty of enforcement as much as from thoroughgoing acceptance, that would apply at least as much in VR as well.

The strobe example likewise shows the value of technologically enabled self-help. Some people like strobe lighting, for aesthetic reasons. It’s also a good way of getting people’s attention for things like alarms, especially for the hard of hearing. And epilepsy can be triggered by other near-strobe effects that are likewise valuable for aesthetics or for verisimilitude. Giving people an option to decide whether to block strobe effects will maximize the number of possible virtual environment designs, while maximizing the virtual environments’ accessibility to the small minority that suffers from epilepsy as well as the majority that doesn’t.

84 See, e.g., State v. Louisiana Toy Co., 483 So. 2d 1264, 1268 (La. Ct. App.) (“[T]hat prosecutions for obscenity might be rare or even erratic does not mean they are arbitrary or discriminatory.”)
86 Photosensitivity and Seizures, Epilepsy Foundation, http://www.epilepsy.com/learn/triggers-seizures/photosensitivity-and-seizures (“Natural light, such as sunlight, especially when shimmering off water, flickering through trees or through the slats of Venetian blinds,” “Television screens or computer monitors due to the flicker or rolling images,” and “Certain visual patterns, especially stripes of contrasting colors.”).
Finally, though more controversially, diversity of options may be relevant even for virtual groping. Most people, we believe, wouldn’t like being virtually groped by people they just met online. But people’s preferences when it comes to sexual (and sexualish) matters are notoriously diverse, and often unexpected to those who don’t share the preferences. And that is especially so when the sexual behavior is relatively low-risk: not sex in the absence of clearly communicated consent; not even physical groping in the absence of clearly communicated consent; but the visual perception of gestures that appear similar to what physical groping would look like in the real world.

Some people, for instance, might find such attempts to be more akin to flirting than to assault, and find the possibility of such attempts to be welcome, even if they rebuff individual instances of the attempts. Indeed, there might be VR spaces where people go in order to meet prospective sexual partners (whether for in-person sex or for the VR equivalent of phone sex) in which such behavior is part of the courtship ritual.

Likewise, there might be VR games in which this behavior is allowed. This could be for verisimilitude: If you’re playing a game set at the Bristol docks in 1750, you might want rude behavior, and the reactions to the behavior, to be part of the gameplay. Or it could be for titillation: We can imagine that some people might fantasize about rough or nonconsensual sex and enjoy the fantasy even though they wouldn’t enjoy the physical experience; a VR version may provide those people with the right combination of realism and fantasy.

Of course, most people, like Belamire, won’t want to be groped. But that’s the point: There is a diversity of sexual preferences. VR offers the possibility that people can control their environment and consent to only what they want.

C. Defaults and the initial intrusion

All this, of course, raises a question that’s a version of Justice Stevens’s Pacifica argument. All the self-protection tools involve the likelihood that people will often be exposed to misconduct—such as loudness, public nudity, or virtual groping—once, or perhaps once per offender, before they block the misconduct. To be sure, potential victims might be able to prevent some of the misconduct at the outset, with the proper configuration, but practically they will often not think about it until the first incident. The tools that will likely be available thus allow what one might see as an initial intrusion, but can stop recurrences.

Should that be considered acceptable? Or should the criminal law try hard to prevent even the initial intrusion? Recall Justice Stevens’ specific analogies:

To say that one may avoid further offense by turning off the radio when he hears indecent language is like saying that the remedy for an assault is to run away after the first blow. One may hang up on an indecent phone call, but that option does not give the caller a constitutional immunity or avoid a harm that has already taken place.88

And indeed the law generally forbids unwanted physical “blow[s]” (though not all unwanted touching), and all indecent telephone calls, including the initial call.89 On the other hand, the law doesn’t forbid unwanted indecent mailings—rather, it lets residents demand that the mailer stop sending them offensive material.90 Likewise, the law can’t categorically forbid door-to-door leafleters from coming to your home, though it can forbid them once you’ve put up a “No Soliciting” sign.91 And many, us among them, don’t think Pacifica is a shining beacon of First Amendment jurisprudence.92

Even in circumstances where people can practice self-help once a threat is identified, then, the law can and should set defaults. A virtual environment could be configured to permit strobing except for those who opt out, or to forbid strobing except for those who opt in. Likewise for showing nude avatars, or allowing physical approaches within some distance.

The law could thus take the view that even an initial intrusion of this sort is a crime unless (1) the environment forbids the intrusion by

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88 FCC v. Pacifica Found., 438 U.S. 726, 749 (1978) (Stevens, J., lead op.).
91 Martin v. City of Struthers, 319 U.S. 141 (1943).
92 FCC v. Fox Television Stations, Inc. (II), 132 S. Ct. 2307, 2321 (2012) (Ginsburg, J., dissenting); FCC v. Fox Television Stations, Inc (I), 556 U.S. 502, 532–35 (2009) (Thomas, J., dissenting). Indeed, Justice Stevens himself erred in trying to explain how Pacifica was consistent with Justice Stevens’ more recent opinion in Reno v. ACLU, 521 U.S. 844 (1997). “Unlike the regulation[] upheld in Pacifica,” Justice Stevens wrote, “the scope of the [Communications Decency Act] is not limited to commercial speech or commercial entities.” Id. at 877. But the Pacifica regulation was not limited either to commercial speech or to commercial entities; the broadcast in Pacifica itself was noncommercial speech carried by a nonprofit, noncommercial radio station. Application of Pacifica Found., 50 F.C.C.2d 1025 (1975) (describing Pacifica as “the licensee of noncommercial educational FM Stations” including “WBAI, New York”); In re Citizen’s Complaint Against Pacifica Foundation Station WBAI (FM), 56 F.C.C.2d 94 (1975), eventually aff’d sub nom. FCC v. Pacifica Found., 438 U.S. 726 (1978) (confirming that the broadcast was indeed on WBAI). This helps show, we think, how hard Pacifica is to reconcile with modern First Amendment law.
default and (2) the user has expressly allowed the intrusion. This might mean that:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Consequence</th>
</tr>
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<tbody>
<tr>
<td>If the environment lets you supply both a clothed avatar and a nude avatar, and by default has others only see your clothed avatar,</td>
<td>then there’s no indecent exposure even when you create a nude avatar, since only people who have affirmatively chosen the see-nudity option will see the nude avatar.</td>
</tr>
<tr>
<td>If the environment lets you supply both a clothed avatar and a nude avatar, but by default lets people see the nude avatar,</td>
<td>then you’re guilty of indecent exposure for using a nude avatar, since people are entitled to be shielded from even the initial intrusion of nudity into their visual field.</td>
</tr>
<tr>
<td>If the environment only lets you supply one avatar, but allows a “clothe this avatar” feature on an avatar-by-avatar basis,</td>
<td>then you’re likewise guilty of indecent exposure for using a nude avatar.</td>
</tr>
</tbody>
</table>

Alternatively, the law could take the view that certain initial intrusions aren’t a big enough deal to justify criminal punishment, so long as they can be quickly dealt with by the offended user. Or the law could take the view—which would yield the same result, though on a different rationale—that the decision to enter the VR environment is consent enough to such quickly-dealt-with initial intrusions, even when entering the VR environment may be required by your desire to access important resources (your VR job, your VR educational program, your access to VR shops).

We’re inclined to think that, so long as the initial intrusion is relatively minor, and can be quickly stopped through technological self-help matters, there’s no need to bring the machinery of the criminal law into the matter. (Tort law might be a different story.)

But this judgment will often turn on just what intrusions you think are minor enough: Unwanted noise? Nudity? Strobe lights? Virtual groping? We have views on the relative severity of these—the law should probably prohibit virtual groping without explicit prior consent, but not unwanted noise and probably not nudity—but reasonable people can differ about where to draw the line. And these questions will become especially complicated once we get to VR environments that go beyond the merely audiovisual, a matter we will turn to below.

**D. Beyond the audiovisual: haptic assault**

So far, we’ve talked about harms that can be caused by the audiovisual features of VR—the only features that are well-developed now. But let’s now turn to features that VR is likely to acquire soon: haptics.
Haptics are to touch what optics are to sight. Existing 2D games have very simple haptics: a Playstation DualShock controller that vibrates when you drive over bumps or run into something, for instance. But the immersive nature of VR can offer quite a bit more.

Gloves that reproduce sensation on fingers are haptics. So are temperature controls that can make VR tourism more realistic. So are devices that could cause feelings of physical resistance, so that a virtual swordfight would yield realistic sensations when your virtual sword hits your virtual opponent’s. And one can also embed haptics and remote control into sex aids—a business called teledildonics.93

Teledildonics raises the possibility of haptic sex crimes. Unconsented-to sexual touching is a serious offense, and should be so even if the person doing the touching is not in the room with you. True, sexually transmitted diseases and unwanted pregnancy aren’t a threat in the virtual world; and some people may be less troubled by unwanted remote fondling through their haptic interfaces than by unwanted in-person fondling. But we think it likely that people will be justifiably upset enough by such unwanted touching that it would merit punishment.

Similar issues come up outside of sex. Say some people enjoy a particular game that’s supposed to simulate a dangerous physical activity (battle, mountain climbing, flying an airplane), but are frustrated that death or injury in the game has no real consequences. They think it makes themselves and other players reckless, and distorts the game’s realism. Playing poker for matchsticks, it is often said, isn’t the same as real poker. Likewise, playing at sword fighting when being speared through the neck just means “Game Over” isn’t as realistic, they think, as it should be.

So they think that players ought to have skin in the game, as it were: Certain events should trigger something bad—not death (they’re not that hard-core) but physical pain. Indeed, paintball players sometimes take the view that the painful sting of being hit enhances the game, by making players work harder to avoid being hit, or just by making the game exciting.94 Likewise, some social psychology experiments punish people who lose a game by requiring them to consume a substance that is extremely unpleasantly bitter, so as to encourage participants to take the game seriously.95

93 No, we aren’t providing a citation. Search for it yourself if you really want to.

94 See, e.g., How to Treat Paintball Welts, https://acpaintball.com/2015/04/22/how-to-treat-paintball-welts/ (“Most players consider paintball well worth the risk of pain, some even welcome the risk to increase the adrenaline and excitement.”).

Imagine then that a VR setup can have an optional hardware feature: a device that produces an electric shock that is not dangerous but is painful. (One might think of it as “algics” rather than normal haptics.96) People who want to play Extreme Sword Fights (let’s call it) must have the device attached, and when they are hit with the virtual sword, they get a real shock.97 Here, unlike our previous examples, we do have actual physical contact with the victim’s body, albeit contact triggered at a distance rather than by someone standing next to you.

So long as the shock really doesn’t pose any serious physical danger, causing the shock by hitting someone in-game wouldn’t be battery. Battery generally requires nonconsensual touching, at least so long as it doesn’t involve a public fight that risks spreading, or serious physical damage that goes beyond mere pain. This is why a wide variety of often painful activities, from football games to mild sadomasochism, are legal.98 And you consented to be hit by a virtual sword—or at least to run the risk of being hit. By contrast, triggering the haptics outside the game—for instance by hacking someone’s VR rig to give them a surprise electric shock—presumably would be nonconsensual.

So far, so good. But consent in a virtual world has some nuances that we might not expect, as we see in the next section.

E. Consent

Say that you’re playing a game, whether VR or not. One of your fellow players steals some of your in-game currency, or embezzles it or defrauds you of it. That theft can have real-world financial consequences: In-game currency can often be bought and sold for real money, and you can even imagine a system in which your in-game assets are replenished, when needed, directly from your bank account or credit card. In-

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96 -algia is the Greek root meaning pain, as seen in words such as “analgesic.”


98 See, e.g., MODEL PENAL CODE § 2.11(2) (providing that consensual conduct is not criminal, even if “it causes or threatens bodily injury,” if “the bodily injury consented to or threatened by the conduct consented to is not serious,” or “the conduct and the injury are reasonably foreseeable hazards of joint participation in a lawful athletic contest or competitive sport or other concerted activity not forbidden by law.”). But see Commonwealth v. Carey, 974 N.E.2d 625 (Mass. 2012) (concluding that sadomasochism that risks causing more serious injury remains punishable assault, even when consensual); Govan v. State, 913 N.E.2d 237, 242–43 (Ind. Ct. App. 2009) (likewise).
deed, many games have currency top-up systems that let players put real money in and convert it to virtual money when they run out. 99

One way to steal virtual money (or a magic sword, or anything else of value) would be to hack into your computer, or physically threaten you in the real world. That sort of behavior should be criminal, though of course it isn’t easy to get police attention for violations of computer crime laws—or even for thefts conducted through such violations—at least unless the crimes cause substantial financial loss.

But our hypothetical player didn’t hack into anyone’s computer, or do anything else that was outside the understood possibilities of the game (whether or not it was against the laws announced within the game). Rather, he just cut off your (virtual) purse and ran off with it. Or he threatened to have his character kill your character if you didn’t give him the money. Or you opened your virtual safe to let him take 10 gold pieces, and he used the access to take 100.

Games sometimes permit such actions. If I fight your character and win, I may be able to loot his body. That sort of looting, if it is “theft” at all, is theft contemplated by the rules of the game. By playing the game I accepted the risk that I might lose virtual currency to an enemy, just as I consented in the sword fighting alpigs scenario 100 to the possibility that I would be hit by a virtual sword.

But now let us assume that what my thief did violates the rules of the game itself. Should that be a crime from the perspective of American law? Or should it be just one of the things that happens in the wolf-eat-wolf world that is Game of Thrones—The Game? 101 Indeed, might it be a valued gameplay feature, which helps create verisimilitude, extra strategic options, and emotional tension? What kind of goody-goody nonsense would Game of Thrones—The Game be if all players actually had to follow Westeros law?

Maybe the remedy for such theft within the game would be an attempt to launch an in-game criminal prosecution, under whatever rules the game environment allows. (Perhaps trial by combat?) Or maybe such thefts would be deterred by the threat of blood feud, or of magical or divine retaliation, all within the game. Just as the possibility of broken treaties is a valuable feature of games such as Risk and Diplomacy, the possibility of theft may be a valuable feature of other games.

One way of conceptualizing this is that playing a computer game (VR or otherwise) might by default consent to everything that could physically happen within the game, whether or not it is legally allowed

100 See supra Part II.D.
101 We’re not sure how much outright theft is currently physically possible in Game of Thrones—The Game; but if it isn’t, it should be.
within the game. This has been labeled the “magic circle” excluding real law from virtual worlds.\textsuperscript{102}

A game could announce that it is departing from the default. For instance, gamers are often frustrated if their opponents use bots or cheat codes to circumvent the limitations under which everyone else operates.\textsuperscript{103} If game makers ban the exploits,\textsuperscript{104} a player could presumably have a civil or even criminal cause of action against the cheater, just as she could pursue a computer hacker who took valuable data off her laptop. And many games in fact do ban hackers and bots, presumably because they think their players want a level playing field in some respects.

But a rule that violations of in-game laws must be dealt with, if at all, using in-game justice (formal or otherwise) seems to us a sensible default for many games. At least it should be an option, and if it is given as an explicit option, it will be one that many games are likely to choose.\textsuperscript{105}

Yet VR involves more than just games. Some environments, including some VR environments, are likely to be used for straight-up commerce, where people shouldn’t have to expect cheating. “Sure, my store is an elaborate fraud—we goblins are notorious tricksters, and widely known within Middle Earth to be evil” may be an acceptable explanation for a “let the player beware” response in a game, but shouldn’t apply when the store is part of a normal VR shopping mall.\textsuperscript{106}

Again, though, the distinction turns, we think, on consent: One consents to more trickery when one is playing a game then when one is engaging in normal commerce. Presumably in most cases it will be clear which environment is one and which is the other. But perhaps there might be need for clear statement rules, so that fraud and theft of in-VR resources would be noncriminal only if something is clearly labeled as a “game,” perhaps with a requirement that the users specifically acknow-


\textsuperscript{103} Abby Ohlheiser, \textit{‘World of Warcraft’ halted an army of cheaters with a massive player ban}, \textit{WASH. POST}, May 15, 2015.

\textsuperscript{104} \textit{Id}.


ledge the possibility of fraud and theft as a condition of playing the game.107

The existence of haptics and algics might also change the calculus. Return to our example of virtual swordfighting, but now assume that someone deliberately violates the rules of the game to inflict more pain than the rules allow.

Say, for instance, that one of the rules of Extreme Swordfighting is that you don’t hit someone who is already labeled as dead or disabled, or someone who has surrendered. But say that you keep hitting me after I’m down, inflicting five shocks in succession rather than the officially allowed one. I’m very upset by your deliberately sadistic behavior, and I try to have you prosecuted.108

As with the theft in the previous subsection, one possible reaction is that this is a crime: I have consented only to those shocks that are within the rules of the game. You have violated the rules, and thus exceeded the consent.

But another possible reaction is that I’ve consented to a broader range of behavior: By playing the game with my shocker enabled, I have consented to anything that you can do (at least short of serious physical injury) with that shocker; indeed, the possibility of cheating may be an understood part of the game.

Here too self-help may play a role. It seems very likely that algic devices, such as the electric shockers, will come with an easy override, and may even be programmable to (for instance) limit the shocks to no more than one every ten seconds, so one will have the time to engage the override. Certainly manufacturers would have lots of incentive to provide such features and tout them to users.

And if you play a game in which repeated shocks are possible, and don’t engage any override that blocks such shocks, that itself might be seen as consent to the shocks—even when the shocks violate the internal game rules. If you don’t like it, shift to a different setting. This will make it possible for you to enjoy more self-protective gameplay, while others can enjoy more transgressive gameplay.

In principle, sexual haptics have some similarities to algics and to other haptics. One doesn’t have to place haptics on one’s erogenous zones, or to enable them even if one has them—just as one doesn’t have to have algics, or to turn on the algics. (Again, VR and AR are better that way than real reality is: Our bodies have biological haptic and algic


interfaces that are accessible to passersby, whether or not we want to
turn them on.)

At the same time, if one walks into a party with one’s haptics turned
on, one might be expecting—as in the real world—that one’s lover would
feel authorized to, say, covertly rub one’s thigh, but that a stranger
would not. And because unauthorized sexual touching is seen as much
more intrusive and offensive than even unauthorized pain in a sword-
fighting game, there may be good reason to require some overt opt-in be-
fore such touching, at least when it moves beyond the thigh and on to
the breasts or genitals (though again recall that this becomes a problem
only if one attaches haptics to those parts of one’s body).

These questions, of course, are already famously contested and com-
plex in the real world. We expect them to be similarly disputed in VR
and AR as well, especially when one moves away from the pretty clear
taboo (you don’t touch someone’s genitals unless there are strong indi-
cations of consent) to borderline questions (when is it OK to kiss some-
one? to caress someone’s butt when dancing?). At this point, without
more knowledge about how sexual haptics are likely to be used, we’re
not sure what the right answer will be, but we think the problem is
bound up with how we think about consent in a particular virtual envi-
ronment.

F. Consent and impersonation

Consent in the physical world—to sex, to hitting, or to fraud—
presents a variety of legal issues. But VR and AR add a couple of new
twists. The first, which we raised above, is that consent can always
change with the environment (game-playing vs. shopping, for instance),
and people may switch virtual environments more often than physical
environments.

A second way VR complicates the picture, though, is that identity is
malleable. If I convince someone to have (virtual) sex with me by pre-
tending to be her boyfriend, that too seems like something at least tort
law would be inclined to punish, though it almost certainly isn’t rape
under the current U.S. definition of the term.109 Perhaps intentional in-
fiction of emotional distress?110 Perhaps the tort of battery, on the theo-
ry that the consent defense is made unavailable because of the fraud?111

utes do treat sex while impersonating a spouse as rape. See, e.g., CAL. PEN. CODE
§ 261(a)(5).

110 See, e.g., RESTATEMENT (SECOND) OF TORTS § 46.

111 See, e.g., RESTATEMENT (SECOND) OF TORTS §§ 18, 19 (nonconsensual of-
fensive touching can be battery); id. § 892B(2) (consent procured by fraud may
be invalid).
Here, too, the possibility of technological self-help might incline the law not to be too quick to intervene. In a world in which people can change their appearance at will, experienced VR users will learn not to assume that we are who we say we are, merely based on our avatars’ names (TaylorSwift? JaneSmith?) and appearance. So before handing over money (or engaging in sex) you will probably want to verify that your prospective partner is who he or she appears to be, perhaps with a shared password or some sort of persistent actual identity.

But not all VR environments will want to require people to disclose their real identities, just as some but not all web pages have “real name” policies. So the law may want to police cases of intentional misrepresentation, at least when there are significant consequences at stake. And, subject to the Bangladesh problem, identity fraud that yields sufficiently serious losses may be one of the acts in which the default legal rule doesn’t give the perpetrator one free pass.

III. TORT, INTELLECTUAL PROPERTY, AND VR/AR PROVIDER LIABILITY

A. Direct tort lawsuits against offenders: the causes of action

So far, we’ve been talking about the criminal law; what about tort law? Let us turn first to the direct tort liability of some of the potential offenders we described above.

In theory, such liability might be possible in many of the circumstances we have identified, even if criminal law won’t apply. For instance, using strobe lights to deliberately cause a seizure in a person one knows is epileptic is likely at least negligence, and possibly also a form of battery, though that question is complicated.\(^{112}\)

For the other scenarios, tort liability would be more of a stretch, but not implausible. Disturbing the peace might be recharacterized as nuisance, at least in a suit brought by “nearby” VR or AR stores whose business is interfered with by the screaming; but, especially as to VR, that would require nuisance law to be modified, for instance by treating VR “places” as tantamount to “uses of land” which nuisance law protects.\(^ {113}\) Nuisance also generally requires either long-term interference or especially serious interference;\(^ {114}\) disturbing the peace law punishes even brief incidents.

Virtual groping might be treated as intrusion upon seclusion; though it happens in “public” places, the intrusion tort can apply even there, to behavior that is seen as intruding on one’s bubble of personal

\(^{112}\) Restatement (Third) of Torts: Inten. Torts to Persons § 101.

\(^{113}\) Restatement (Second) of Torts § 822.

\(^{114}\) Restatement (Second) of Torts §§ 821D, 821F cmt. g.
space.\textsuperscript{115} Indecent exposure might qualify as well. Both might also constitute intentional infliction of emotional distress, even in the absence of physical touching, on the theory that they are both “outrageous,”\textsuperscript{116} though that tort generally requires a showing of severe emotional distress where there is no physical contact.

Tort law can also reach a wide array of conduct that wouldn’t be a crime even in the physical world. Defaming a VR avatar should be a tort, even if the avatar is pseudonymous.

One of us has had an extended debate with a well-respected federal judge who believed it was impossible to defame an avatar because avatars weren’t real, so their reputation couldn’t be injured.\textsuperscript{117} This “it’s just a game” sense might pervade VR for some time in the courts, in part because most judges are unlikely to be early adopters of VR. But we think such a view is misguided.\textsuperscript{118}

Corporations can sue for defamation, because people invest time and money to create reputational capital for the corporation.\textsuperscript{119} There’s no reason why the same wouldn’t apply to a pseudonym that is used to do business, in VR or otherwise—or to one that is used for ordinary life. The idea that falsehoods that damaged the reputation of Mark Twain weren’t defamatory unless they expressly mentioned Samuel Clemens strikes us as unsound.

The damages to a pseudonym’s reputation might be less in many situations than the damages to a real person’s reputation, because many pseudonyms have built up less reputational capital, and people can take on new ones with little loss. But they could be quite great in other situations, if—as is true in some Internet circles and will likely be increasingly true in VR—the pseudonym or avatar is better known than the person’s name, which might be obscure or even deliberately concealed.

\begin{footnotes}{115} Restatement (Second) of Torts \S 652B.\end{footnotes}

\begin{footnotes}{116} See, e.g., State Rubbish Collectors Assoc’n v. Siliznoff, 240 P.2d 282 (Cal. 1952) (threats); Bundren v. Superior Court, 145 Cal. App. 3d 784 (1983) (telephone calls rudely demanding payment from a person who the caller knew was recovering from surgery); Esposito-Hilder v. SFX Broadcasting, Inc., 665 N.Y.S.2d 697 (N.Y. App. Div. 1997) (radio talk show describing plaintiff as the “ugliest bride” in a newspaper’s wedding announcement section). Reasonable minds could differ over whether virtual grogping should be thought to involve “physical” touching, but the conduct might reasonably be viewed as outrageous enough that it shouldn’t matter.\end{footnotes}

\begin{footnotes}{117} Lemley, Dubious Autonomy, supra note 102, at 576. No, we won’t tell you who it was. What happens in the hallways outside conferences stays in the hallways outside conferences.\end{footnotes}

\begin{footnotes}{118} Id; Lastowka & Hunter, Laws, supra note 106, at 72–73.\end{footnotes}

Most readers probably couldn’t come up with the real name of The Weeknd, but that doesn’t mean we couldn’t defame him.  

B. Direct tort lawsuits against offenders: practicalities (and impracticalities)

Tort lawsuits against VR and AR offenders have one important advantage over criminal prosecutions: They are available even when the police are unwilling to intervene. For example, even if the police don’t want to spend their time on a difficult investigation—especially when they think the complainant could have avoided the problem using technologically enabled self-help—the complainant can still demand his day in court.

Practically speaking, though, we doubt that people will often sue each other for most VR or AR behavior. First, again, there is the Bangladesh problem. VR torts might involve tricky jurisdictional questions; if you’re screaming in a VR forum from your apartment in Poland, is it fair to require you to answer lawsuits filed in San Francisco or in Buenos Aires?

People have litigated that question extensively in Internet cases. But even if a court in, say, California concludes that it has jurisdiction over the Pole (perhaps because the Pole targeted strobe lights at a person who he knew to be in San Francisco), enforcing a judgment against someone half a world away would likely be very hard, and in any event many defendants would lack the money to satisfy a judgment.

Second, while police refusal to go forward wouldn’t be a barrier to civil lawsuits, the cost of such lawsuits might be. However distressed one might be by virtual groping, it’s unlikely that one would be willing to spend tens of thousands of dollars tracking down the culprit, suing him, and trying to recover the judgment. Some people might, perhaps to send a message, but that would be rare.

And abbreviated procedures that are aimed at making lawsuits cheaper and easier—such as small claims trials or restraining orders—won’t help much. A small claims court might be reluctant to allow a lawsuit against someone far away, even if jurisdiction is in principle available; any judgment, moreover, would still be costly to enforce.

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120 Try this: Selena Gomez is too good a singer for him.

121 Comparative negligence is generally not a defense to intentional torts, though of course outright consent would be. RESTATEMENT (SECOND) OF TORTS § 892A.


123 Some small claims courts are limited in their jurisdiction over out-of-state defendants. See, e.g., N.Y. CITY CIV. CT. ACT § 1801 (limiting New York
And the police may be as reluctant to go after a faraway restraining order violator as they are to go after a faraway flasher or screamer.

C. Tort lawsuits for physical injuries to outsiders

VR and AR users will sometimes also physically injure outsiders. A player chasing a Pokemon might run into someone,\textsuperscript{124} or might cause damage by trespassing on someone’s property.\textsuperscript{125} A VR user wearing a headset might walk into a houseguest. Those injuries will often be the fault of the user herself, or someone else using the system. But sometimes the injury may result from flaws in the design of the VR or AR hardware or software itself. And that opens a second, more practical possibility: suing the hardware or software designer itself.

These design defects should be analyzed using normal tort law rules. Just as a car or bicycle manufacturer may be liable for physical injuries caused by defects in the device, so a VR or AR equipment manufacturer may be liable. If a defect in an AR headset, for instance, causes it to flash a very bright light that temporarily blinds users and leads them to run into people, that sounds no different from a defect in a bicycle’s brakes that leads the rider to run into someone.

Many such defects would stem from the VR or AR system providing incorrect information to people—for instance, an AR system defectively instructing you to turn in the wrong place, or a VR system that claims to sense whether someone walks into your room but then defectively fails to properly report it. The fact that information is involved complicates things, because the publication of information—even false information—might implicate the First Amendment. For instance, the Ninth Circuit has held that the publisher of the Mushroom Encyclopedia isn’t strictly liable when you poison yourself because the Encyclopedia had bad information.\textsuperscript{126} On the other hand, the publisher of a flawed aeronautical chart is strictly liable when you use the chart to fly into a mountain.\textsuperscript{127}

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\textsuperscript{125} Richard Winton, \textit{Police fear the dark side of ‘Pokemon Go’}, L.A. TIMES, Jul. 12, 2016. We set aside VR or AR defects that cause pure trespass, without damage. Negligent trespass is generally not actionable absent damage. RESTATEMENT (SECOND) OF TORTS § 165. Likewise, a manufacturer’s negligence in leading someone to trespass should generally not be actionable without damage, either.
\textsuperscript{126} Winter v. G.P. Putnam’s Sons, 938 F.2d 1033 (9th Cir. 1991).
\textsuperscript{127} Brocklesby v. United States, 767 F.2d 1288 (9th Cir. 1985).
\end{flushleft}
Even if the Mushroom Encyclopedia case is correct, we think incorrect directional information provided by VR and AR that makes you walk into a wall is more like the incorrect directional information provided in aeronautical charts. Even more than with charts, people generally rely on instructions provided by their VR and AR headsets automatically, with no opportunity for reflection. Indeed, that is the whole point: If a VR headset shows a pathway for you to walk down, you’re supposed to walk down it. That assumes that the VR system is supposed to know where walls and other obstacles are, but they generally do.\textsuperscript{128}

The Ninth Circuit’s effort to distinguish aeronautical charts from the Mushroom Encyclopedia is a little opaque, but it supports our position:

Aeronautical charts are highly technical tools. They are graphic depictions of technical, mechanical data. The best analogy to an aeronautical chart is a compass. Both may be used to guide an individual who is engaged in an activity requiring certain knowledge of natural features. Computer software that fails to yield the result for which it was designed may be another. In contrast, The Encyclopedia of Mushrooms is like a book on how to use a compass or an aeronautical chart. The chart itself is like a physical “product” while the “How to Use” book is pure thought and expression.\textsuperscript{129}

Even if a mushroom encyclopedia is “pure thought and expression,” because it teaches how to do something, a VR or AR headset is far from that. Instead, it’s an even more automatic “guide” than a compass: It offers visual cues that the users is meant to follow without thinking. It is like a physical product, albeit one composed in large part of information.

\section*{D. Using tort law to draft VR/AR operators into preventing misbehavior by users}

Plaintiffs won’t want to limit suits against operators just to errors in the systems themselves; they may also want to hold operators liable for users’ misconduct. Individual users may be hard to sue, but VR and AR operators—both software and hardware providers—will not be. They will usually be easily identifiable, and will often have assets in many of the jurisdictions in which their users live. Users who believe they have been harmed while participating in a VR environment might thus sue, not the tortfeasors themselves, but the VR operators for negligently contributing to their injuries.

Generally speaking, American negligence law holds that people who provide physical spaces—such as shopping malls—have a duty of rea-

\textsuperscript{128} See, e.g., Oculus, Oculus Guardian System, https://developer3.oculus.com/documentation/pcsdk/latest/concepts/dg-guardian-system/ (“The Oculus Guardian System is designed to display in-application wall and floor markers when users get near boundaries they defined.”).

\textsuperscript{129} Winter v. G.P. Putnam’s Sons, 938 F.2d 1033, 1036 (9th Cir. 1991).
reasonable care to safeguard their business visitors from physical harm. The theory is one of negligence, not of strict liability or vicarious liability: A shopping mall owner wouldn’t be liable simply because a visitor was criminally attacked by another visitor. But if there were reasonable, cost-effective, not unduly burdensome steps that the owner could have taken to prevent reasonably foreseeable crime, and the owner didn’t take the steps, then the owner could be held liable.

This negligence theory would clearly apply to AR that is under a physical property owner’s control. Say that a shopping mall provides an AR network to its customers—perhaps so they can more easily find their way to stores, or see what’s available in a store, or just communicate with friends and thus better enjoy the shopping experience. And say that someone uses the network to target a customer for a strobe-light attack. If (1) the attack was reasonably foreseeable, (2) the AR software could have easily and inexpensively provided an option that customers could use to block strobing, but (3) the AR software failed to do that, then the shopping mall owner might well be liable for any damage that the attack caused. There would be no need for any extension of existing law; that would already be the result today.

But what about VR, which we use on our own real estate? Or what about an AR system that is provided entirely by AR operators who are unrelated to any shopping mall that we might happen to be visiting? There, the existing duty of a property owner to business visitors wouldn’t arise. Instead, courts would have to consider whether to recognize a new duty, not based on ownership of real estate but based on ownership of “virtual estate,” in the sense of a VR environment that feels to people like a “place,” even if it is not one, or an AR environment that is superimposed on the places that people are visiting.

The rationale for such a duty might be that the VR or AR operator, like a real estate owner, is uniquely situated to provide software protections that users cannot themselves provide. Conversely, if the VR and

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130 RESTATEMENT (THIRD) OF TORTS: PHYS. & EMOT. HARM § 51 (2012).
131 Id.
132 See, e.g., Castaneda v. Olsher, 162 P.3d 610 (Cal. 2007).
133 See, e.g., Kline v. 1500 Massachusetts Avenue Corp., 439 F.2d 477 (D.C. Cir. 1970). If the attack was unforeseeable, then the attacker’s voluntary act would be viewed as “breaking the chain of causation,” and the shopping mall’s actions would be seen as not being a proximate cause of the attack. But if the attack was foreseeable, proximate cause would be seen as present even though the immediate cause of the harm was the attack itself. See, e.g., RESTATEMENT (THIRD) OF TORTS §§ 19, 34.
AR environments are open enough that people can easily buy and run their own apps that provide, say, anti-strobing protection, that would cut against imposing such a duty on the VR/AR operators.

Perhaps, though, such a new duty wouldn’t even be necessary, because—unlike in the physical world—VR and AR operators are, however unintentionally, affirmatively contributing to VR- and AR-based attacks, rather than just failing to stop them. If I can send you strobing images via a VR system, the VR system is itself an unwitting participant in the process, a factual cause of any injury you suffer.

This doesn’t make it strictly liable, of course. But perhaps it does impose on it a duty of reasonable care to make sure that its system doesn’t cause such harm. As the Restatement (Third) of Torts puts it, “An actor ordinarily has a duty to exercise reasonable care” when “the actor’s . . . course of conduct results in greater risk to another than the other would have faced absent the conduct,” including “by exposing another to the improper conduct of third parties.”

This duty is the foundation for many negligence theories, such as negligent entrustment and negligent supervision:

- If (1) I give you access to a car or a gun, (2) I should have known that you couldn’t be trusted with such devices, and (3) you do harm someone by misusing the device, then I can be sued for negligent entrustment (on the theory that I’ve affirmatively contributed to the harm by lending you the device).

- If (1) you are an independent contractor whom I’ve engaged, (2) I fail to reasonably supervise you to make sure that you aren’t misusing your powers under the contract, and (3) you do cause harm through such misuse, then I can be sued for negligent supervision (on the theory that I’ve affirmatively contributed to the harm by bringing you into my project).

Likewise, if we cross negligent entrustment and negligent supervision, we get the following duty, which is already long established in copyright infringement as well as some tort cases:

- If (1) I give you access to my flea market, (2) I fail to reasonably supervise you to make sure that you aren’t selling copyright-infringing products, and (3) you do sell such products, then I can be sued for contributory copyright infringement.

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135 Restatement (Third) of Torts: Phys. & Emot. Harm § 7(a) & cmt. o.


137 Fonovisa v. Cherry Auction, 76 F.3d 259 (9th Cir. 1996). This duty is limited by statute for online service providers, though not entirely eliminated. 17 U.S.C. § 512.
If (1) I give you access to my computer system, (2) I fail to reasonably supervise your use of the system, and (3) you use it to distribute nude photos of your stepdaughter, then I could be held liable for negligent supervision.\textsuperscript{138}

By the same logic,

If (1) I give you access to my VR environment, (2) I fail to reasonably supervise your use of the environment, and (3) you use it to tortiously injure someone, then I could be held liable for negligent supervision.

We think courts should hesitate to impose such liability, especially when the proposed supervision or precautions would seriously interfere with other users’ privacy or freedom. Say, for instance, that Tom defrauds Paul while using the Delta Corporation’s VR environment; Tom had a past criminal conviction for fraud; and Delta could have prevented the fraud by just doing a background check on all its users (assume it has their names because it requires them to provide nonanonymous credit cards to participate).

If Paul can successfully sue Delta for negligently enabling this fraud—essentially by negligently entrusting the system to the known fraudster third-party Tom—then Delta would have a strong incentive just to bar people with criminal histories from its system. Or if Paul can successfully sue Delta for negligently enabling the fraud by failing to warn people of Tom’s criminal history, then Delta would have a strong incentive to overtly label everyone with a criminal conviction who is using its system. (Perhaps a scarlet \textit{F}, for fraud, on the avatar’s chest?)

Such an approach might be appealing to some, despite the burden it imposes on user privacy and the extra burden it places on people with criminal convictions even after they have served their sentences. VR and AR environments might want to tout their background checks as a means of attracting users, just as Uber publicizes that it does background checks on its drivers.\textsuperscript{139} And perhaps a legislature might conclude that VR and AR companies should have a duty to do this as well, though this might raise interesting First Amendment problems.\textsuperscript{140}

But we don’t think that juries should be making such decisions, especially on an \textit{ex post} basis, in a case brought when plaintiff has been

\textsuperscript{138} Doe v. XYC Corp, 887 A.2d 1156 (N.J. Super. Ct. App. Div. 2005). That case involved misuse of a computer system by the employee of the system’s owner; but its logic didn’t turn on the employment relationship, and would apply to other system users as well.

\textsuperscript{139} Rachel Feintzeig & Rachel Emma Silverman, \textit{In the Uber Age, a Boom in Background Checks}, WALL ST. J., May 10, 2016.

\textsuperscript{140} Stephanie Rosenbloom, \textit{New Online-Date Detectives Can Unmask Mr. or Ms. Wrong}, N.Y. TIMES, Dec. 18, 2010.
injured and when the effects of imposing liability will be felt by third parties who aren’t present in court. Courts ought to hold as a matter of law that there is no tort law duty to impose such privacy- and liberty-compromising precautions.141

If those precautions are to be legally required, they should be required only as a result of a legislative decision directed to certain specific kinds of precautions and specific kinds of misconduct, not a jury verdict that could arise in any VR negligence case. The law does not similarly require Internet service providers or cell phone providers to supervise the conduct of their users, at least outside the bounds of contributory copyright infringement. And we worry that the consequences of imposing such a duty would cause other, larger problems: restricting user privacy and limiting what individuals can do even with consent.

At most, courts should allow such negligent supervision lawsuits only when the claim is that defendant failed to implement reasonably inexpensive and effective technological self-help measures that don’t involve excluding users or disclosing information about them. Even then we’re not sure that such measures should be required through the unpredictable operation of the tort liability system, as opposed to through clearer, narrow regulations or through market pressure. But at least such requirements would increase the diversity of choices available to users, rather than decreasing them; more on this diversity shortly.

E. 47 U.S.C. § 230 as a limit on VR/AR operator liability

We also think it’s likely that, under current law, VR/AR operators would be immune from liability for most misconduct by their users, because of 47 U.S.C. § 230. Section 230 generally bars any “interactive computer service” provider from being held liable based on “information provided by another information content provider.”142 This is why, for instance, services such as Yelp, the Washington Post, YouTube, and America Online aren’t liable for defamation, invasion of privacy, or intentional infliction of emotional distress in items posted by their users.143

The story of § 230 is long and oft-told, and we won’t repeat it here.144 But the upshot is that § 230 would probably immunize VR and AR operators from offensive textual, audio, or visual communications by their users, likely including indecent exposure, virtual groping, and the like.

It would probably immunize them even from communications that cause physical harm, such as the deliberately harmful use of strobe lighting.

At the same time, some recent courts have read § 230 more narrowly, perhaps because of a sense that rampant misconduct online requires someone to control it, in an environment where direct lawsuits against those who are misbehaving are impractical, and the police are unlikely to step in.\textsuperscript{145} It is possible, though not certain, that courts will take a similar view when it comes to VR and AR operators, especially since the service they provide feels so different in many ways—so much more physical—than what the paradigm beneficiaries of § 230 offer. And haptic torts seem likely to be seen as not covered by § 230 at all.

\section*{F. Tort liability for physical injury to users; terms of use as contractual limits on liability}

Finally, VR and AR defects are likely to also lead to injury to the systems’ own users. Here, the analysis will be much the same as in the previous subsection, but subject to any enforceable terms of use that might waive liability to the users themselves.

Those limits, though, are likely to be substantial. The ubiquity of “consent” to terms of use may mean we will see relatively few VR and AR legal disputes brought by users in the courts. Unlike in Part II.E, here we mean not informed consent to having someone hit you with a virtual sword, but the fictional consent we consumers give whenever we are held to have agreed to terms of use that exist somewhere in a box or on a web page.\textsuperscript{146}

All the VR and AR legal issues we have discussed are likely to arise, at least in the foreseeable future, in the context of private, proprietary systems. Everything you do in VR—both personal experiences in your own home and interactions with others—occurs in a computer environment that is privately designed, recorded, and controlled. The same is true for the overlays that AR provides over your experience of the real world. For that reason, they are likely to be covered by the VR and AR operators’ terms of use.

It is too soon to know exactly what this will mean for the law of VR and AR. But we have some experience with so-called “walled gardens” in

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electronic communications. And that experience suggests that makers of the platforms have almost plenary authority to do what they want without legal complaint from their customers, at least when it doesn't involve physical injury.

That is particularly true when it comes to potential economic loss. Users of Apple phones, for instance, have access to the public internet and phone networks but are at the whim of Apple’s decisions of what apps they can and cannot run. Apps can be dropped from the store, and if they are, users lose any investment they made using the app. Players of massively multiplayer online role-playing games (MMORPGs) invest substantial time and resources in creating and leveling up avatars and accumulating resources—but that investment exists only so long as the game remains live, and only so long as the company doesn’t boot the player off the system.

Waivers of liability would likely also likely cover injuries to privacy or other emotional distress. If a VR or AR operation wanted to disclaim any liability stemming from indecent exposure, virtual groping, and the like, it could do so. The question whether such operators are hypothetically liable under some negligent supervision or entrustment theory, or have 47 U.S.C. § 230, may thus prove to be largely moot.

You are also likely bound by the terms of use even when you haven’t read them, and thus haven’t agreed to them in any normal sense of the


148 Lastowka & Hunter, Virtual Crimes, supra note 105.


152 While the user might not be the person who bought the system, that likely won’t matter. Putting on the headset is likely to be treated as agreeing to terms of use by most modern courts. See, e.g., NANCY S. KIM, WRAP CONTRACTS (2014); Mark A. Lemley, Terms of Use, 91 MINN. L. REV. 459 (2006).
word. And precisely because those terms are not negotiated or read, they tend to give the companies that write them lots of rights and few responsibilities.

The ubiquity of terms of use is not new, of course. The same problem infects web sites. But the effect of those terms is likely to be greater in VR and AR than it is in web site visits. VR systems are likely to collect not just data about you but other sensitive information, particularly if (as seems likely) one early use of VR is for virtual sex. And as we have seen, the importance of consent to physical contact and other behavior is likely to be much greater in VR and AR than it is in web site visits.

VR and AR may thus represent the acceleration of a trend begun with the Internet: the tendency of contract law to swallow property and tort law. Unless the law changes, VR and AR legal obligations (or their absence) will likely be determined mostly by the dictates of contracts written by VR and AR companies.

VR and AR operators’ liability for negligent physical injury or even negligent property damage, though, may not be as easily waived. Many states are less likely to enforce waivers that are part of nonnegotiable form contracts. Many are also less likely to enforce waivers when an activity is seen as practically necessary—not just if it’s medical care, but possibly also auto repair—rather than just as entertainment.

VR and AR might at first seem like a form of recreation, which may cut in favor of enforcing the waivers. But as they become more important for employment and business, they may indeed come to be seen as practical necessities. So perhaps in the comparatively rare situations where physical injury is possible in VR and AR, and the provider is seen as negligent for not taking reasonable steps to prevent the inju-

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153 Id.


155 See, e.g., RESTATEMENT (THIRD) OF TORTS: APP. LIAB. § 2 & cmt.e.

156 See, e.g., Tunkl v. Regents, 383 P.2d 441 (Cal. 1963) (holding a waiver of negligence liability as to medical care, even charitable care, unenforceable).

157 See, e.g., Randas v. YMCA of Metro. L.A., 17 Cal. App. 4th 158 (1993) (holding a waiver of negligence liability in a swimming class to be enforceable). But see City of Santa Barbara v. Superior Ct., 161 P.3d 1095 (Cal. 2007) (holding a waiver of gross negligence liability to be unenforceable even as to recreational activity).

158 See, e.g., Gardner v. Downtown Porsche Audi, 180 Cal. App. 3d 713 (1986) (holding a waiver of negligence liability in a contract with a car repair shop unenforceable, when the shop’s negligence allowed the car to be stolen).
ry, the waiver that the provider requires users to sign might be ineffective.

G. Copyright and trademark liability to outsiders

Let us now turn to liability that isn’t preempted by terms of use (because it involves the rights of people who aren’t themselves VR or AR users), and is expressly exempted from 47 U.S.C. § 230 immunity: liability for copyright and trademark infringement.

Say that you are designing your own avatar. You could make it look as much like yourself as possible, receding hairline, love handles, and all. But, as we mentioned above, one of the exciting things about VR is the malleability of your identity. Why not make yourself just a bit younger and more attractive? Or change your hair color?

For that matter, why not experiment with a different race, or gender, or species? Freed of biology, and of the need for permanence, people will experiment with all kinds of images to represent themselves. And while some will try to create something new, some will just copy. Why not look like ... Superman? Lara Croft? The Cat in the Hat?

Copyright and trademark lawsuits against VR/AR users who create such avatars, or companies that sell them, would likely operate much as they have now, though with many of the uncertainties we see now. Fictional characters’ images coupled with their unusual character traits are protected by copyright. If you copy enough of the visuals, character traits, or both to be copying expression and not just idea, you might be infringing. What if you just wear a red-and-blue superhero costume with a cape but no S? What if the game lets you have certain superpowers, and you also have your character appear and disappear by appearing to fly? Answering questions like that is why IP lawyers get paid the big bucks.

If your use is noncommercial, and licensed avatars aren’t already being distributed by the copyright owner, your use might be a fair use. But if someone goes into business selling such avatars without the copy-

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159 Well, for some of us, anyway.

right owner’s approval, such a use would probably not be a fair use.  It might also be trademark infringement.

Copyright and trademark owners, though, might well not want to go after individual users, or even small-time fly-by-night avatar sellers. Instead, they might sue the VR or AR operators as contributory infringers. The environment operator might be immune under the Digital Millennium Copyright Act, but only until someone sends the operator a notice-and-takedown request; and then the operator would have to promptly block the allegedly infringing avatar, or risk losing a lawsuit.

There is an established body of case law that sets out the limits of intermediary liability under the DMCA. There is less clarity on intermediary liability for trademark infringement on the Internet, but there too the law is developing. But the legal issues—and their practical consequences—may differ somewhat in the VR and AR environments.

First, while there are certainly opportunities for outright copying of works or logos in VR, we expect that many of the allegations will be against user-generated works that incorporate or modify those works, particularly copyrighted works, rather than wholesale duplication of the kind that is common online. Those user-generated works can still be infringing, but they are more likely to be transformative and less likely to be commercial, complicating the copyright case and raising the likelihood of overzealous enforcement by copyright owners.

Second, the use of AR is likely to generate some novel copyright issues involving derivative works. One way to infringe copyright is to combine your work with another in a way that creates a new work or changes the market for that work. AR users may do exactly that whenever they place a virtual Pokemon “in” a work of sculpture, visually merge the copyrighted work that appears in their phone or glasses with

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163 See, e.g., Viacom Intern., Inc. v. YouTube, Inc., 676 F.3d 19 (2d Cir. 2012).

164 See, e.g., Tiffany (NJ) Inc. v. eBay Inc., 600 F.3d 93 (2d Cir. 2010); Mark A. Lemley, Rationalizing Internet Safe Harbors, 6 J. TELECOM. & HIGH TECH. L. 101 (2007).

an actual work that appears in front of them, or use filters that alter the appearance of copyrighted works.

True, those new derivative works are just passing things, not permanent alterations, at least unless the user takes a photo. But some case law has treated such ephemeral changes to a copyrighted work as infringing.\textsuperscript{166} Courts will have to decide whether and under what circumstances a user’s subjective viewing of a derivative work not visible to others—or the facilitation of such an act—constitutes copyright infringement.

Finally, the consequences of copyright infringement under the DMCA may be more significant for the infringer in VR than on the Internet. To comply with the DMCA, intermediaries must agree to take down identified acts of infringement and to terminate the accounts of repeat infringers.\textsuperscript{167} On the Internet, neither penalty is all that drastic—or all that effective if you are a copyright owner. It is easy enough to repost a video that has been taken down, and frequently not that hard to create another account from which to do so.

But it is harder to know what it means to “take down” a VR avatar that infringes copyright or trademark law, so companies may err on the side of caution by deleting the account altogether. And we think people will be more invested in their VR accounts than in a particular online account with a particular web site, so the consequences of VR infringement under the DMCA may turn out to be higher than on the Internet.

IV. HOW OTHER PEOPLE SEE YOU, EVEN IF YOU DON’T SEE IT

A. Your role in others’ personal sensescapes

So far, we have spoken of intrusions on VR or AR users’ own sensescapes—actions that cause them to see, hear, or feel things that are offensive or even harmful to them. But what if other users decide to include you in their sensescape, even in ways that you might not directly perceive?

Our inclination is towards what we call “freedom of sensescape”: People should generally be free to see and hear whatever they want in their own VR displays, even when the material is offensive or may lead some people to behave badly. (We would say the same as to AR, except for rules aimed at preventing distracted driving and the like.) The contents of one’s own VR sensory feed are very close to the contents of one’s thoughts and fantasies. Banning people from displaying VR images to

\textsuperscript{166} See, e.g., Lewis Galoob Toys, Inc. v. Nintendo of America, Inc., 964 F.2d 965 (9th Cir. 1992); Atari, Inc. v. North American Philips Consumer Electronics Corp., 672 F.2d 607 (7th Cir. 1982); Micro Star v. Formgen Inc., 154 F.3d 1107 (9th Cir. 1998).

\textsuperscript{167} 17 U.S.C. § 512.
themselves simply because it offends others (even the subjects of the images), or may lead to bad behavior, should be as improper as trying to punish people for unexpressed fantasies, or for notes written in their own diaries.

But what if my sensescape offends you, because it refers to you in certain ways, even if you don’t personally experience it? We suggested earlier that users can engage in self-help by turning down your volume if you are too loud, virtually clothing your avatar as it appears on their AR or VR display, or keeping you out of their personal space, all without your consent or perhaps even your knowledge, merely by changing their local software setting. But if the software provides such control, it won’t always be used to prevent crimes or torts.

What if people instead make your avatar appear naked to their eyes without your knowledge or consent? Naturally, they probably won’t be able to make it look like your naked body actually looks, unless they have some photographs of your naked body. But they can just merge your face and your gestures and motions with a generic computer-generated naked body tailored to your physique and skin tone.

Or what if your “personal space” bubble prevents you from perceiving other avatars as groping you, but they can still see themselves groping you? True, software companies might design a system in such a way that all parties had to share a common visual version of events. But there’s no guarantee that this is the way systems will indeed be designed, and some reason to think that software companies would want to give each user more flexibility. For instance, if you and we go to a VR bar together, why not let each of us perceive the décor of the bar in the way that we most like, for instance if you like a loud dark crowded bar and we like a quiet well-lit uncrowded one?

What’s more, in AR, all this can happen when the people are physically right next to each other. If they can load a software program onto their glasses that reminds them of your name and your kids’ names while talking to you at a cocktail party, what if they instead load your most embarrassing picture from a social media site while looking at you, or a fake “nude” image of you?

From one perspective, we might react by saying, “you can’t see the naked person or the groper; problem solved.” You are not confronted with something that offends you or that you perceive as an assault, so you do not suffer injury.

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168 See supra Part II.A.2.

169 Fake celebrity porn—photoshopping someone’s head onto an image of a naked body—is a real thing. This one too you can look up for yourself if you really want to.
It’s creepy if you find out about this later, or if you see signs that this is happening right now. But “creepy” doesn’t mean illegal. No law, for instance, prevents someone in the privacy of their own home from masturbating while thinking about you or looking at your picture, even if you really don’t want them to.\(^\text{170}\)

On the other hand, you may well be upset when you learn that you are being viewed (here, literally viewed) disrespectfully. And this might especially trouble you when you are in virtual or real personal proximity to the people who are viewing you that way: People who are (in their subjective experience) virtually ogling or groping you may treat you differently in that interaction—physical interaction when it comes to AR, virtual interaction in VR—than if they weren’t doing so.

Of course, if this is just what people themselves see in their individual headsets, no one will be the wiser. But information about how they’ve configured their systems might come out, whether through discovery in litigation, a search under a warrant, or a hack. And even if it doesn’t, the possibility that people are doing this may affect how we interact with others in VR, or even in the physical world with people who are wearing AR.

This creepiness may well be reason for companies to ban or restrict some kinds of perception. But we don’t think it makes such behavior illegal. That is true even for otherwise unprotected speech. Possessing child pornography depicting actual children may be banned, the Supreme Court said, because the possession itself stimulates a market for the creation of the speech, creation that involves criminal harm to the children. But display of speech that was not created as a result of criminal conduct is protected.\(^\text{171}\)

Indeed, the Supreme Court’s *Stanley v. Georgia* decision, which held that mere possession of obscenity cannot be punished, fits well with this principle:

> Whatever may be the justifications for other statutes regulating obscenity, we do not think they reach into the privacy of one’s own home. If the First Amendment means anything, it means that a State has no business telling a man, sitting alone in his own house, what books he may read or what films he may watch. Our whole constitutional heritage rebels at the thought of giving government the power to control men’s minds.\(^\text{172}\)

That is even more apt, we think, for the contents of one’s VR display. And the law of disclosure of private facts, false light invasion of privacy, and the right of publicity fits the freedom of sensescape as well: Those

\(^{170}\) We’re not personally at much risk of this, but we understand others might be.


Torts don’t even apply to material shared with a few friends, and even more clearly don’t apply to material displayed for one’s own benefit.\(^{173}\)

None of this is to say we shouldn’t be bothered by this sort of conduct. VR and AR companies may want to ban or restrict it, or at least to warn people that it is (or might be) happening. Our point is only that it isn’t illegal.

### B. Display to others

Now let’s take a step away from purely individual decisions to view another’s avatar differently. Say that John decides to configure his own VR system to substitute a different avatar for your own when he sees you in VR; but say that he also shares this with Jack, Jerry, and Jane. And say that avatar is in some way disrespectful.

Maybe John thinks that you are a fascist and decides to draw a little Hitler moustache on you, or put a swastika armband on his image of your avatar; and all his friends then copy that design. Indeed, maybe John announces to the world that this substitution is available to anyone who wants it (assuming the VR/AR environment makes it easy for people to do that). John might view that as a political statement, and so might the people who copy from him.

If you’re of our generation, think back to the Doonesbury cartoons that constantly represented Dan Quayle as a feather, Bill Clinton as a waffle, and Arnold Schwarzenegger as a giant groping hand. What if VR and AR users could do the same, not just in their sensescapes, but in the sensescapes of others who were willing to follow the user’s lead?

And what can be done for political reasons can also be done out of personal spite or cruel humor. John could share with his friends an avatar that is a grotesque caricature of an acquaintance’s (say, Alan’s) appearance, perhaps exaggerating some unattractive feature of Alan’s. Or John could share with his friends an avatar of their acquaintance Alice apparently naked, which is to say Alice’s face merged with a plausible-looking naked body.

Human nature being what it is, we expect there to be a good deal of this sort of behavior. And while much of it would be sophomoric, we think that on balance it should be protected by the First Amendment, especially since it can be used for political, social, religious, and artistic commentary.

One question is whether publicizing sexually themed adaptations of others’ avatars—an avatar that is configured to look like the user naked, even when the user has not chosen this—should be treated differ-

\(^{173}\) See Restatement (Second) of Torts § 652D cmt. a. Libel law also doesn’t apply when the speaker displays material solely for his own benefit. See Restatement (Second) of Torts § 577(1).
ently. Should such nonconsensual sexualization of others’ images be forbidden by law, by analogy to the recent movement to forbid to nonconsensual distribution of real sexual images (often labeled “revenge porn”)? Or does the fact that everyone understands the nudity to be faked lead the image to retain its First Amendment protection? Courts are beginning to litigate this question in the context of fake celebrity porn, though those cases are surprisingly rare, perhaps because none of the victims want to call more attention to the offending sites, or perhaps because the defendants are probably judgment proof, or in Bangladesh.

On the legal merits, privacy torts like “false light” invasion of privacy (if the images are fake), defamation (if they are fake but are presented as real), or public disclosure of private facts (if the image is real) all seem plausible responses to fake celebrity porn. But in VR, presumably no one thinks your naked avatar is “real”—it is, after all, an avatar. That makes these tort theories, focused as they are on factual assertions, much tougher to sustain.

C. Pervasive display

So far, we’ve talked about how you choose to alter others’ avatars. But what if you are designing your own avatar, and you deliberately choose someone else’s name and appearance, perhaps to mock that other person, or perhaps to impersonate them?

Say that someone creates an avatar in a popular VR environment. He calls the avatar Eugene Volokh (or Mark Lemley), and he makes it look like Eugene Volokh. (Recall that we’re assuming avatars that are highly lifelike, something that will likely arrive within the next few years.) Then this “Eugene Volokh” starts traipsing through the VR environment, saying and doing all sorts of foolish things.

Now maybe we could sue for libel, or even seek criminal punishment under various state laws that ban impersonation. But say that it’s clear that this isn’t the real Eugene Volokh; for instance, say that the VR world has a special marker for people who are admittedly pseudonymous (e.g., by displaying a scarlet P for “pseudonym” on the front of

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177 See, e.g., People v. Golb, 23 N.Y.3d 455 (2014).
their avatars). Reasonable observers would therefore realize, on a moment’s reflection, that this isn’t the real Eugene Volokh.

If this were a movie, then this use of a real person as a character, as in Forrest Gump or Midnight in Paris, would be permissible, even protected under the First Amendment, notwithstanding any possible “right of publicity” claim.\textsuperscript{178} It might be parody, or a fictionalized account of real events, or just entertainment, humorous or not. But so long as a reasonable person would perceive it as something fictional, rather than as making factual assertions about the real person, it wouldn’t be actionable, either as libel, false light invasion of privacy, or infringement of the right of publicity.

By the same logic, it may well be that designing an avatar that uses the name and likeness of a real person as an obviously fictional character in a VR or AR environment should likewise be permissible. This may indeed be the right answer, and there is real value in such a conclusion. Letting people play others online, especially when it’s clear that this is just a pseudonym, can be a useful means of parody, commentary, and entertainment.

But perhaps such avatar design should not be allowed unless the person whose name and likeness is used consents, because the visceral quality of VR might make a difference. If you see a movie with a Eugene Volokh character, you don’t just know you’re seeing a movie—you feel that you’re seeing a movie. You’re sitting in your armchair, with the movie visibly on a screen in front of you. You have a popcorn bucket in your hand, or a snack on the coffee table. You probably see other viewers in front of you or beside you.

But if you see an avatar in a VR world, you’re seeing it in a context specially designed to mimic reality as much as possible. When you turn your head, the illusion created by VR is reinforced, not broken. In more advanced VR systems, you might be walking around on a two-dimensional treadmill rather than just sitting in your armchair.

Moreover, you’ll see the avatar not in some special context that you bring up just to see impersonations (e.g., a Saturday Night Live broadcast). Rather, you might see the avatar in your ordinary “travels” in the VR environment. Even if you logically recognize that the avatar is a pseudonym, it will feel like a person named “Eugene Volokh.” And you might see the avatar fairly often, if he goes to the same on-line conferences or chat rooms or bars that you frequent.

The danger, then, is that your experience of the fictional “Eugene Volokh” will color your perception of the real Eugene Volokh. Even if you intellectually know that the dumb or rude things that “Eugene Volokh” says weren’t really said by the real Eugene Volokh, when you actually meet the real Eugene Volokh those things may still taint your view of him. Perhaps you won’t take what he says as seriously. Or perhaps you’ll work hard to try to put the fake “Eugene Volokh” out of your mind while interacting with the real one, but that very process will distract you from your real interaction.

This, of course, is much like the concern that animates the law of trademark dilution by tarnishment. The law prevents people from producing Dogiva dog biscuits, even when consumers won’t likely be confused into thinking that the dog biscuits are really from the people who make Godiva Chocolates. It’s enough that the dog biscuits might taint the associations of the chocolates, and may make the chocolates less appetizing.

To be sure, trademark dilution law is limited to commercial uses; the use here is noncommercial, and perhaps that should be relevant. Moreover, trademark dilution law is limited to “famous marks,” ones “widely recognized by the general consuming public of the United States.” Our concern is actually with the opposite. If there is an avatar who is named “Justin Bieber,” and who looks like Justin Bieber, this probably won’t color your perception of the real Justin Bieber: You’re more likely to viscerally perceive the avatar as just a pseudonym, and because your mental image of Justin Bieber is going to be more molded by Bieber’s much larger media presence. Rather, our concern is for people who aren’t particularly famous; they are the ones whose identity is most likely to be diluted by avatar impersonation.

If this argument is right, then perhaps the right of publicity should have a broader scope as to VR and AR avatars than in other contexts, including as to noncommercial uses. Or perhaps we should be satisfied with some form of labeling, in much the way we distinguish “Real Donald Trump” from other Donald Trumps on Twitter by using a blue verified check mark.

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179 See, e.g., 15 U.S.C. § 1125(c); CAL. BUS. & PROF. CODE § 14202.


182 Some have likewise suggested that truly famous names and marks are actually hard to dilute. See, e.g., Louis Vuitton Malletier v. Haute Diggity Dog, 507 F.3d 252, 267 (4th Cir. 2007);

183 Though the right of publicity is generally applied just to commercial uses, some older cases suggest that even noncommercial appropriation of another’s name or likeness might sometimes be actionable. See RESTATEMENT (SECOND) OF TORTS § 652C cmt. b.
We are inclined to be cautious in expanding both the right of publicity and the trademark dilution theory. The right of publicity has generally to exclude noncommercial uses, and we think that this is no balance an important safeguard. The scholarship on dilution is at best inconsistent, and we have argued elsewhere that dilution law, like right of publicity law, raises significant First Amendment concerns. But at a minimum the visceral nature of VR presents an interesting test of the theory of tarnishment; and as we learn more about how VR is actually experienced, we might find that our views have to change.

V. PERVERSIVE INFORMATION CAPTURE

Finally, the fact that these contracts will vest rights with the hardware and software providers compounds another significant aspect of VR: because it is all software that captures your motion and activities and responds to them, there is a record of everything you do in VR. That record likely exists not only on your computer but also in the cloud. The company probably has broad access to it under the terms of use. VR companies might or might not store it depending on space and legal constraints.

True, such pervasive information capture happens with your Internet browsing habits and data on your smartphone. The devices and sites you use track and store more than you think. But the data needed to make VR and AR work must not only generate a record of where I am and whom I interact with at any given time, but may also save records of intimate acts and conversations. And the visceral, visual nature of those records may make us more concerned about the privacy of those records than we are about most of our texts.

Indeed, this sort of retention might be billed as a valuable feature for users, who can then have a “life log” that they could review or search later to refresh their memories or relive or show others interesting moments. But it may happen even when users would rather that it didn’t happen, especially when it comes to their interactions with others who do choose to keep such life logs.

And the retention might also be useful for in-system dispute resolution systems, for instance if users dispute the terms of a commercial transaction they entered into online, or claim that they were libeled or

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otherwise injured. Perhaps there might be, for instance, a form of internal subpoena, where people can require the production of any conversations that involved them. That offers the promise of helping resolve many of the kinds of disputes we discussed above, either by providing evidence in court or by facilitating dispute resolution outside the legal system.

Maintaining such records, though, will also facilitate government investigations in circumstances in which the law does seek to intervene. That will sometimes be good. But it can also be abused. Presumably all such recordings would be subject to subpoena—but only if they’re kept in the first place.187 Should they be? Under current Fourth Amendment law there is no constitutional barrier to such subpoenas or even outright searches (on the theory that one can’t have a strong expectation of privacy in data one turns over to VR and AR companies188). But should there be some sort of privilege, developed by common law or by statute, either requiring a high showing of relevance for such subpoenas, or perhaps even categorically banning them (as would be the case for most attorney-client-privileged or priest-penitent-privileged information, for example)?

VR and AR operators need to consider all these questions, and VR and AR users need to consider what they want, especially if different operators adopt different policies. How long should the systems maintain records of in-system interactions? Should they let individual users erase their own records? What records should be kept for possible future dispute resolution? And the legal system needs to consider how broadly such records should be made available to the government and to litigants.

To be sure, there may be practical limits to data capture. VR generates a lot of data—too much to practically transmit and store on an ongoing basis, at least today. That fact might itself mean that while everything that happens in VR generates data, we may not keep much of that data for very long. But perhaps as storage gets ever cheaper and quicker, even that will not be a barrier.

VI. CONCLUSION: THE LIGHT VR AND AR CAN SHED ON LEGAL DEBATES MORE BROADLY

As promised, we have just sketched some of the more interesting legal issues that VR and AR are likely to generate. But some of this anal-

187 Some have argued that there should be a warrant required in such cases. See, e.g., Jonathan Mayer, Constitutional Malware, __ YALE L.J. __ (forthcoming 2017).

188 See, e.g., United States v. Jean, 2016 WL 4771096 (W.D. Ark. Sept. 13, 2016) (summarizing caselaw on the limits to Fourth Amendment protection in material that users communicate to computer service providers).
ysis, we hope, can also reflect on broader legal debates. Let’s briefly re-
cap some such possibilities.

A. Order without (much) law

For various reasons, we might see crimes, torts, and other problems
arise in VR without the legal system doing much about it. The Bangla-
desh problem will mean that enforcement will often be too difficult, es-
pecially as to the less serious crimes and torts that we’re likely to see in
VR and AR. The availability of technologically enabled self-help will
give people a cheap alternative to calling the police and going to court,
and will in turn make police even more reluctant to intervene. VR and
AR operators’ ability to contractually waive liability, coupled with 47
U.S.C. § 230, will likely discourage lawsuits against the operators.

And this relatively lack of government-imposed law may not be bad.
There is a natural tendency for legislators or courts to intervene to try
to solve perceived problems with new technologies. But the best way to
nurture a new technology can sometimes be for the law to leave it alone.

Anupam Chander has argued that a series of (largely accidental) de-
cisions in the early history of the Internet created safe spaces in which
companies could innovate without the fear of government regulation.189
The same may prove true of VR and AR. We don’t yet know how these
technologies will develop, both technologically and culturally. Setting
legal rules too early risks rendering those rules irrelevant as the tech-
nology moves in unexpected ways.190 Worse, legal rules can channel or
stifle the development of technology. So a generally hands-off approach
to regulation of VR and AR is probably good, at least for now.

At the same time, many of the problems we discussed above are (or
are likely to become) real ones. In the absence of legal regulation, VR
and AR communities can and should develop their own norms to govern
permissible and impermissible social interactions. VR and AR compa-
nies (both hardware platforms and software companies) can also con-
tribute by considering and adopting best practices for behavior. Opera-
tors could set up dispute resolution systems within the environment
they run, whether for quality-of-life matters or for commercial transac-
tions.

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189 Anupam Chander, How Law Made Silicon Valley, 63 EMORY L.J. 639
(2014); Mark A. Lemley, IP in a World Without Scarcity, 90 N.Y.U. L. REV. 460

190 See, e.g., Jane Kaufman Winn, Open Systems, Free Markets, and Regu-
lation of Electronic Commerce, 72 TUL. L. REV. 1177 (1998) (discussing examples of
legal regulation of emerging technology that became irrelevant because the
technology moved in an unexpected direction).
There are, however, limits to private ordering as a solution to disputes that arise in VR and AR. We are likely to see those limits tested when operators seek to insulate themselves completely from liability for any sort of injury (as they invariably will). Many of the potential harms involve the risk of physical or at least serious psychological injury. That makes it important that consent at least be a real thing, not merely a conclusion that somewhere there is a terms of service contract posted and I am deemed to have agreed to it by turning my machine on.\textsuperscript{191}

There is a good argument that courts have stretched the definition of consent too far in the browsewrap cases generally.\textsuperscript{192} But even if contract law continues to enforce these terms in general, courts are increasingly pushing back on specific provisions that seem unfair or surprising to consumers and that are contained in contract forms the consumer had no effective opportunity to review.\textsuperscript{193} Consent should mean informed consent, not simply a legal acknowledgement of the existence of boilerplate somewhere. And in the real world even clear waivers of liability often don’t apply to negligent or intentional physical harm.\textsuperscript{194}

\textbf{B. Virtual reality and the speech-conduct distinction}

VR and AR will also challenge our understanding of what is speech (or, more precisely, communication)—and thus strongly protected by the First Amendment and other norms—and what is nonspeech conduct that merits regulation. Is a nude avatar like nudity on a drive-in screen (speech) or like indecent exposure (conduct)? Are avatars apparently having sex like sex scene on a drive-in screen (speech, though perhaps in some situations within the obscenity exception) or public lewdness (conduct, and indeed a sex crime)?

Is virtual non-haptic groping like the display of an image (speech) or like unwanted touching, or the threat of unwanted touching (conduct)? Is the display of a scene that leads the user to walk off a cliff, or even just into his apartment wall, more like an error in the Mushroom Encyclopedia (speech) or an error in an aviation chart (treated by the law as conduct)?

There are good reasons in the physical world to distinguish between words and actions and between words and things. Some of the lines turn

\textsuperscript{191} Joshua Fairfield argues that terms of use contracts cannot suffice to create legal rules for virtual worlds; we need some public law in those worlds. Joshua Fairfield, \textit{Anti-Social Contracts}, supra note 146.

\textsuperscript{192} See, e.g., Kim, supra note 152; Lemley, supra note 152.

\textsuperscript{193} For recent efforts to rein in the reach of browsewrap contracts, see Nguyen v. Barnes & Noble, Inc., 763 F.3d 1171 (9th Cir. 2014); Specht v. Netscape Comm’ns Corp., 306 F.3d 17 (2d Cir. 2002); Meyer v. Kalanick, __ F. Supp. 3d __, 2016 WL 4073012 (S.D.N.Y. July 29, 2016); Muhammed v. Uber Techs., 109 F. Supp. 3d 1185 (N.D. Cal. 2015).

\textsuperscript{194} See supra notes 156 & 158.
out to be difficult to draw, and some of the results might not make a whole lot of sense. But the basic distinction makes sense in the physical world because we think the harm words can cause at a distance is generally less (and easier to avoid) than the harm of physical contact.

VR and AR, though, are deliberately created to make communicated images and sounds feel like real life. The technologies challenge our perception of the real because they blur the cognitive line between imagery and physical presence. People react to a virtual slap as if they had actually been slapped. The reaction is visceral; it doesn’t involve real physical contact, but it feels real in a way.

That requires us to consider why we restrict things like indecent exposure when we don’t restrain images of the same things, and whether the physical reality or the perception should be the driving force. And that in turn raises fundamental questions about what counts as harm, in VR and AR or outside it.

C. The virtual, the real, and the nature of harm

The self-help options we discussed above, unlike systemic limitations on what can happen, change only my lived experience and not yours. If I exercise the option to avoid seeing you naked, you may not know about it. As far as you know you’re naked in front of me, but my experience is that you are clothed.

We might be fine, even happy, with that difference. It allows a sort of live-and-let-live freedom of sensescape in which our vision of what happens differs. We might even think that if freedom of sensescape should be a baseline legal norm of VR, it will often require that different people perceive things differently.

But maybe that shouldn’t satisfy us. Does the ability to prevent my perception of bad things mean that they don’t injure me? That turns out to be a hard question that gets at some pretty fundamental issues around the nature of harm. If the harm is my physical or psychological experience of seeing you naked (or being virtually groped), much and perhaps all such harm can easily be avoided by giving me control over how you appear to me and how you can interact with my avatar.

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195 See supra Part I.C.2.

196 For a similar discussion of whether Internet law should consider the way the Internet actually works or the way it seems to users to work, see Orin Kerr, The Problem of Perspective in Internet Law, 91 GEO. L.J. 357 (2003).

197 The exceptions will be things like defamation, fraud, and the right of publicity, because they affect how I am viewed by third parties. My reputation is injured by your defamation even if I never learn about it. Indeed, the harm
But maybe we should still be worried about even second-party perception. If I can superimpose clothes on your naked avatar, you can presumably do the opposite, viewing me as naked even when I am subjectively wearing clothes, or making me appear to you as Donald Trump or Hillary Clinton. You probably find that creepy in VR. It will be even creepier when it happens in AR. Similarly, even if I have a personal bubble in which you can’t grope me—from my perspective—you might be subjectively experiencing a world in which you are groping me.

We might worry that this subjective or unshared experience will have corrosive effects on the real world. If you perceive me as naked when you are talking to me you are likely to treat me differently in that conversation, and perhaps treat me differently afterwards. It is not clear that the law should, or even can, regulate that behavior. But perhaps we should worry about the effects of that behavior as a society.

This in turn requires us to think seriously about some distinctions we take for granted—between presence and remoteness, between speech and conduct, and between what is real and what is “merely” perceived. If it turns out that the reason we ban indecent exposure is in part about perception and psychic harm rather than physical threat, that might cause us to rethink what it means to be hurt in a way the law cares about. If it turns out that we care about the perpetrator’s subjective perception of reality, not just the victim’s, that suggests a much broader notion of what we would punish if we only knew about it. And that has implications not just for the virtual world but also for the real world.

We don’t have definitive answers to these questions. But the very existence of VR and AR poses the questions in new ways, ways that can illumine the assumptions the law makes about freedom and harm in the physical world as well as the virtual world. For that reason alone, it is worth paying attention to the developing law of virtual and augmented reality.